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THE AMERICAN GAS LIGHT JOURNAL

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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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[OFFICIAL NOTICE.]

Appointment of a Committee of Reception by the American Gas Light Association.

AMERICAN GAS LIGHT ASSOCIATION, OFFICE OF SECRETARY, PROVIDENCE, R. I., June 5th, 1893.

The following named members of this Association are appointed and respectfully requested to serve as a Committee of Reception, whose duty shall be to call upon all foreign gas engineers visiting our country during the continuance of the World's Fair at Chicago, whose names and addresses may be obtained, and to introduce them to other members of our profession, see that they obtain permits to visit the neighboring gas works and other objects of interest, and generally to make their stay in New York as pleasant as possible, and when they leave for Chicago, to give them letters of introduction to the Committee of Arrangements at Chicago: Messrs. Wm. Henry White (chairman), Eugene Vanderpool, William H. Bradley, Fred. S. Benson, William R. Beal, Jos. R. Thomas, Thos. F. Rowland, Jr., Fred. W. Floyd and Oscar Weber.

The Guild of Gas Managers and the Society of Gas Lighting are respectfully requested to co-operate with this committee in extending hospitality to our visiting professional brethren.

A. E. BOARDMAN, President.

A. B. SLATER, JR., Secretary.

[OFFICIAL NOTICE.]

The American Gas Light Association's Greeting to European Gas Engineers.

AMERICAN GAS LIGHT ASSOCIATION, OFFICE OF SECRETARY, PROVIDENCE, R. I., June 5th, 1893.

To the European Gas Engineers—Greeting: The American Gas Light Association will hold its 21st annual convention in the city of Chicago, beginning on the date of Wednesday, October 18th, 1893. It would give the members of the Association great pleasure to meet there as many of the European gas engineers and managers as can make it convenient to be in attendance at the World's Fair at that time. It is suggested that all contemplating visiting the Fair arrange their visits so as to be in Chicago, if possible, at the time of this convention, when they will be most cordially welcomed by the Association and invited to attend the sittings of the body and participate in its discussions of papers presented.

Those engineers who cannot conveniently visit the World's Fair at that time, but must choose some other date, are respectfully requested to send their names and addresses, as soon as they arrive in America, to the AMERICAN GAS LIGHT JOURNAL, No. 32 Pine street, New York City, so that a committee from the Association may be made aware of their presence, and when they may be met, so that they may form the acquaintance of their professional brethren in this country and be made to feel less like a "stranger in a strange land."

A. E. BOARDMAN, President.

A. B. SLATER, JR., Secretary.

BRIEFLY TOLD.

THE ALBANY (N. Y.) COUNCIL REFUSES TO CHARTER AN OPPOSITION COMPANY.—Prior issues of the JOURNAL have contained ample reference to and comment on the proposition made to the Council of Albany, N. Y., by the promoters of the Albany Light and Power Company, for the right to operate an opposition gas and electric lighting Company in that city, and now we have it to say that the Law Committee of the Council handed in an adverse report on the petition, which adverse report was subsequently endorsed by the Board with practical unanimity; for out of a total of 18 voting, only three "Noes" were recorded. The Committee in giving the reasons for their conclusions say: "Public hearings in said applications were had, at which arguments were heard

in support of and in opposition to said resolution. That your Committee, convinced that the question of obtaining cheaper gas in the city of Albany, is one of momentous importance, and commends itself to all consumers of gas, has given this application much careful consideration, and, while your Committee is fully satisfied that the present Gas Company in our city could and should materially reduce the price of gas furnished to its consumers, yet the Committee doubts that such reduction or any permanent benefit can or would be secured by granting the application asked for in the resolution under consideration. The Committee, therefore, feels compelled to report adversely to granting the privileges asked for in the resolution and application, and trusts that the question of cheaper gas will soon be solved either by the voluntary action of the present Gas Company, or by the influence of legislative sanction, or by concerted action of our citizens and local capital." Taken as a whole, this is an admirably framed document, since it is candid, fair and reasonable, and puts the whole matter in a proper light. It is notoriously a fact that the gas rate at Albany is too high, and it is a further fact that the existence of such an excessive charge is a standing menace to the gas interests-at-large of the State, in that it causes ill feeling amongst the residents of Albany towards the local Company in particular, and prompts the attention of the inhabitants of other gas-consuming centers of the State to watch closely the outcome of the agitation. The Committee, the members whereof no doubt (at least the majority) are in close political sympathy with the Brady-Murphy political syndicate that has dominated local affairs at Albany and Troy with such telling effect in respect of personal advantage and advancement, makes no attempt at defending the local Company, but reaches the point of denying the opposition application on the broad and safe ground that two wrongs never yet developed one right. Beyond a doubt, the surest way to keep the gas rate up at Albany would be to charter an opposition Company, but as this is not to come to pass at present, it is just possible that Mr. Brady and his associates will appreciate the necessity that exits for some concession on their part to the gas consumers who furnish them with some of their golden eggs. Nor will this concession be unbusiness-like nor unprofitable, as it is sure to result in a largely increased output on the one hand, and an immense gain in local standing on the other. To conclude with, it is somewhat reassuring to be furnished with an example of a report from a set of municipal rulers that is fair and just all around.

FIRST ANNUAL MEETING OF THE PACIFIC COAST GAS ASSOCIATION.—We are in receipt of unofficial advices respecting the organization meeting of the Pacific Coast Gas Association, all of which go to show that an eminently successful convention was held. The business sessions of the meeting were held at the office of the San Francisco Gas Light Company, the convention being called to order at 10 A.M. of July 11th. The attendance was large, representative and enthusiastic, and the organization and subsequent proceedings were completed without a hitch. The officers chosen for the ensuing year were:

President—Mr. J. B. Crockett, of San Francisco.
Vice-President—Mr. J. L. Hallett, of Portland, Ore.
Secretary and Treasurer—Mr. J. A. Britton, of Oakland, Cal.

The next annual meeting will be held at Sacramento, Cal., on the 11th July, 1894. The technical portion of the proceedings was very interesting, the papers read being the following: "The Benefits to be Derived from the Formation of a Gas Association on the Pacific Coast," by Mr. J. B. Crockett. "Is the Electric Light Friend or Foe to the Interests of Gas Lighting," by Mr. J. L. Hallett. "Gas as a Fuel," by Mr. John Mather, Seattle, Wash. The discussion of these was lively and instructive, and the Question Box also contributed largely to the interest of the sessions. On the evening of the first day the members and their guests participated in a very prettily arranged testimonial banquet, tendered the Association by the San Francisco Gas Light Company, which was served in inimitable style at the celebrated "Maison Riche." On the second day the Union Iron Works were visited, where the members had a chance to inspect the United States war vessels that are being there constructed—it is also worthy of note it was at these works that the mammoth new holder for the San Francisco Company was designed and turned out. Subsequently the party visited the Protrero Station of the Gas Company, and at noon a visit to the Company's North Beach Station (the site of the Company's magnificent new plant) was made. Here a very pretty and substantial luncheon was served, after which the plant was inspected at leisure, and its magnitude and completeness thoroughly comprehended and admired. There can be no doubt about it that "the borning" of the Pacific Coast Association was satisfactory in every sense, and that a lusty future is before it. We hope to print a complete report of the proceedings.

Gas Lighting and Ventilation.

[A Lecture delivered by VIVIAN B. LEWES, F.I.C., F.C.S., before the Incorporated Gas Institute, at its Thirtieth Annual General Meeting.]

The subject of gas illumination and ventilation has been so often before the Institute that I fear the title that I have chosen will conjure up in your minds the idea that I am about to spend the time allotted to me in a dissertation on various forms of ventilating burners and their action upon the air of our gas-lighted rooms. Nothing, however, is farther from our intention than this; and if you will bear with me for a short portion of the time whilst I lay the foundation of my subject, I hope I shall be able to bring before you some considerations which will be new to many present.

Most of my experimental work has been done with the gas supplied by the London Companies, the present composition of which is shown in the following analyses:

Composition of London Gas, May 26, 1893.

	South Metropolitan Gas Company.	The Gas Light and Coke Company.
Hydrogen	50.16	53.36
Unsaturated hydrocarbons	3.50	3.58
Saturated hydrocarbons	36.25	32.69
Carbon monoxide	5.68	7.05
Nitrogen	4.10	2.50
Carbon dioxide	0.00	0.61
Oxygen	0.31	0.21
Sulphureted hydrogen	nil	nil
	100.00	100.00
	Grains per 100 Cu. Ft.	Grains per 100 Cu. Ft.
Ammonia	0.6	0.2
Sulphur compounds	12.0	10.5

And 100 cubic feet of these gases will yield on complete combustion:

	Cu. Ft.	Cu. Ft.
Carbon dioxide	56.0	51.0
Water vapor	140.0	134.0
Sulphur dioxide	0.0192	0.168

The volumes of carbon dioxide given were experimentally determined; and the slightly higher result yielded by the South Metropolitan Company's gas is due to the presence of some of the higher saturated hydrocarbons, probably from enrichment by the Maxim-Clark process.

Combustion, however, in ordinary burners is never absolutely complete; and even with a 16 candle gas, very slight traces of carbon monoxide will generally escape combustion, whilst with a rich gas distinct traces of acetylene are also given off. In any ordinary room, however, the quantities of sulphur dioxide and the products of incomplete combustion are so minute that it is almost impossible to detect them, and absolutely impossible to estimate them with any approach to accuracy—indeed, our senses are so much more delicate than our chemical reagents in detecting such contamination, that smell and brain will detect the vitiation long before a sufficiently large trace is present to give any satisfactory analytical results. We will first consider the action of the more important products of combustion—carbon dioxide and water vapor—on the atmosphere of a confined space, such as an ordinary room.

It is manifest that, in order to obtain any given amount of light, the volume of gas consumed, and therefore the amount of vitiation produced, must entirely depend upon the form of burner used. On examining the burners in general use in most districts, it will be found that at least 90 per cent. of them are flat-flame burners of common construction, which have been purchased more with a view to cheapness than with any idea of developing the light giving power of the gas consumed. The largest number of burners will be flat-flame burners of the size known as 4 and 5, which are popularly supposed to consume four and five cubic feet of gas per hour respectively, although, with the ordinary pressure of gas turned fully on to them, as is generally found to be the case, they will often consume nearly double this amount, and yield an extremely low quantity of light. In nearly every case where a Vestry or Corporation complain of insufficient illuminating power given by the public lamps, it will be found that this is due to the street-lamps being fitted with cheap burners, of a kind absolutely unsuitable for the gas, and also to the pressure not being properly regulated. With the hollow-top flat-flame burners manufactured by an English maker of repute, and with the gas supplied to it at a proper pressure, it is possible to obtain as much as 3 candle power for every cubic foot of gas consumed; whilst it is quite possible to find burners in many London lamps, which appear identical in construction, yielding only 1-candle power per cubic foot of gas consumed. The whole secret of this enormous difference is that

the burners have been made at a cheap rate in Germany, without any idea of the quality of gas to be burned, and have had the slits made far too narrow, so that the admixture of too large a proportion of air during combustion has practically destroyed two thirds of the luminosity—such burners only holding their own in the market on account of the low price at which they can be obtained. There is no doubt that, if Vestries and Corporations were to leave the selection of the burners to the Gas Companies, or else take the advice of competent experts upon the class of burner which it would be most economical to use with gas of the quality supplied, the increase in illuminating power would soon more than pay for any extra expense which might be entailed.

As regards consumption of gas in private houses, it will be found that nearly all the nipples used are No. 4 or 5; and, in experimenting with the gas supplied in the city, which has an illuminating value giving an average of 16.5 candles, these burners yield results which compare most unfavorably with the light obtained from the consumption of the gas either in Argand or in regenerative burners.

Service Yielded by Ordinary Burners Consuming 16.5*-Candle Gas.*

Burner.	Illuminating Value per Cubic Foot of Gas.
Flat-flame, No. 6	2.5 candles.
" No. 5	2.1 "
" No. 4	1.9 "
London Argand	3.3 "
Regenerative	10.0 "

It must also be borne in mind that the universal use of such unsuitable burners not only means enormous waste of gas—a consideration not at all likely to worry the gas manager—but it also entails a very great increase in the vitiation of the atmosphere of our dwelling-rooms, which means encouraging the demand for electric lighting. It is usual to gauge the amount of vitiation in the atmosphere of a room by the per centage of carbon dioxide present; and although this is by no means an accurate index of the absolute action of such air upon health, yet it affords a rough-and-ready indication which is sufficiently near the truth for ordinary purposes. Taking now a large dining-room, which would require an amount of light equal to (say) 48 candles, the following table will show the amount of 16 candle gas consumed, and the volume of carbon dioxide generated per hour in producing it; whilst to make the meaning clearer, I have added the number of adults who would exhale the same amount of carbon dioxide in the same time:

Gas Consumed and Carbon Dioxide Produced to Yield an Illumination Equal to 48 *Candles.*

Burner.	Gas Consumed.	Carbon Dioxide Produced.	Adults.
Flat-flame, No. 6	19.2	10.1	16.8
" No. 5	22.9	12.1	20.1
" No. 4	25.3	13.4	22.3
London Argand	15.0	7.9	13.1
Regenerative	4.8	2.5	4.1

I think this method of stating the case brings out in a startling way the importance of giving more attention to our methods of gas consumption; but I must also point out that, although the use of regenerative burners would reduce the amount of vitiation to one-fourth or even one fifth, yet too much blame must not be put on the gas. If we obtain the same amount of light from paraffine lamps, the carbon dioxide evolved would be equivalent to 22.5 adults; whilst you might as well invite 32.7 more guests to dinner as use 48 sperm candles to supply the needed illumination.

Leaving this phase of the question, let us now examine the atmospheric condition of an ordinary sitting-room, without any special means of ventilation other than those supplied by the usual door, fire-place and window. An average sample of 16-candle gas will evolve 50 cubic feet of carbon dioxide for every 100 cubic feet consumed; and in an ordinary sitting-room, 12 feet broad by 16 feet long and 12 feet high, an ordinary 3-jet chandelier would take five hours to consume this quantity. If there are two people in the room, they will have exhaled 6 cubic feet of carbon dioxide during this period, making the total volume of this gas generated during the five hours up to 56 cubic feet. The capacity of the room is 2,304 cubic feet; so that this amount will represent 2 per cent. But when one experimentally determines the amount actually present, one finds that, under the conditions stated, the 3 feet next the ceiling contain 0.4 per cent. of carbon dioxide; the next 3 feet only 0.2 per cent., and the 6 feet nearest the floor an average of 0.07 per cent. That is to say, the total amount of carbon dioxide present only amounts to 0.18 per cent. of the air present, or less than one-tenth of the gas evolved—showing that the total air of the room has been changed at least twice an hour during the period in which the gas has been burning. In these experiments, the door was kept as far as possible shut; and the ventilation was therefore practically due to the fire place, faulty work and diffusion through the walls and ceilings.

If I might be allowed, I should like to mention at this point the question of the alleged injurious effects produced by sulphur compounds in coal gas. A short time ago I had the honor of corroborating Dr. Olding's evidence given in support of the Crystal Palace District Gas Company's Bill, to the effect that an increase in the sulphur compounds allowed in the gas from 20 up to 30 grains per 100 cubic feet would not practically cause any injury to the consumers; and this seems to have roused the ire of certain gentlemen in Manchester, who, having been brought up in the belief that sulphur is the root of all evil, felt that this was rank heresy. I am glad, therefore, to have the opportunity of stating the reasons which led me to the conclusion I came to on the subject.

I have already described an experiment to show that, in an ordinary room, nine-tenths of the products of combustion are removed without any special appliances. For every 100 cubic feet of gas containing 20 grains of sulphur consumed, there would be formed 0.035 of a cubic foot of sulphur dioxide; whilst with 30 grains the amount would be raised to 0.048. This, except under very exceptionable circumstances, would be reduced in quantity by ventilation in nearly the same ratio as the carbon dioxide; and the total volume of sulphur dioxide due to the combustion of the gas would be reduced to so minute a trace that it is beyond the power of ordinary analyses to accurately estimate it—the probable quantity being roughly 1 10,000th of 1 per cent., or 0.0622 of a grain of sulphur as sulphur dioxide per 100 cubic feet of air.

The view which has always been put forward is that the sulphur dioxide generated by the burning of the sulphur compounds does not diffuse with the other products of combustion, but becomes at once converted into sulphuric acid by combining with the moisture and oxygen present in the atmosphere; but experiment shows that it is only under special conditions, never likely to be arrived at in a room in which gas is burning, that this could possibly take place. If dry sulphur dioxide and dry oxygen be mixed together, even in an undiluted condition, they will remain without any action taking place. If water vapor be present, no reaction will occur unless the water vapor condenses into liquid drops. I have had mixtures of sulphur dioxide and moist air standing for long periods without the slightest contraction taking place, proving conclusively that no formation of sulphuric acid could have occurred;* and, inasmuch as the condensation in the moisture of the air of a room can only take place when the saturation point of the air is reached, it is manifest that the percentage of water vapor present in the atmosphere will play a very important part in determining the action.

The percentage of water vapor in the air of a room in which gas is burning is found to be highest near the ceiling, and to decrease the lower one comes in the room; but it is not the percentage of moisture which determines the deposition of liquid water from the air, but the degree of saturation—*i. e.*, the power which the air has of holding up the water vapor—a factor which increases with great rapidity with rise of temperature. Experimenting in the same room in which the previous determinations were made, it was found that near the ceiling, at the end of the five hours during which the gas was burnt, the degree of saturation was 40 per cent.—that is to say, the air could have taken up, or held as a vapor, 60 per cent. more moisture than it possessed—whilst near the floor, the degree of saturation amounted to 78 per cent., or in other words, it could only have taken up 22 per cent. more water vapor. This condition shows that, at the temperature existing in the room, no condensation of moisture could take place unless the air came in contact with a cold surface, such as the window panes on a cold night, when the moisture would condense upon the glass. In this moisture, distinct traces of sulphuric acid would be found; whilst in the air of the room which would be in contact with the draperies and furniture, and which would be inhaled by the inhabitants of the room, no conversion of the sulphur dioxide into sulphuric acid would take place, and the sulphur dioxide diffusing with other products of combustion would never practically rise above the minute proportion before stated.

In order to prove the deleterious effects of this hypothetical formation of sulphuric acid, certain observers have brought forward many experiments to show that, in passing the air through absorbing solutions, sulphates could be detected in the solutions in small and varying quantities. This, however, certainly does not prove that sulphates were present in the air, as directly the sulphur dioxide is absorbed by the liquid, the oxidation to sulphuric acid takes place with considerable rapidity; and it is this which has given rise to wrong deductions from the observed facts of sulphuric acid, either free or in combination, being found in

* This has also been proved by Professor Harold B. Dixon, as well as by Mr. Vernon Harcourt.

wetted fabrics, or on moistened plates or liquid absorbents exposed to the air of rooms in which gas has been burnt, also on lamp glasses and in ventilating tubes in towns where no limit is placed on the amount of sulphur present in the gas.

A very favorite argument, which has been employed in showing the amount of sulphuric acid present in the air, is the rotting action which the air in the upper part of a room has upon books and other articles of leather. But here again the main factor has been overlooked, and many other causes of error have crept in. Leather is a substance which has the power of absorbing moisture; and in doing so, the absorbed mois ture will fix sulphur dioxide, and allow it to be converted into sulphuric acid, although only to a small extent. In this way traces of the acid are produced, and will in time undoubtedly act upon the leather; but the results which have been observed, and which have done duty on so many occasions, are a great deal more dependent upon the sulphur dioxide which is found in all town air than upon the sulphur dioxide pro duced by the gas. The researches of Dr. Angus Smith and Dr. Russell show conclusively that, in the air of the larger towns and their suburbs, there are very considerable traces of oxides of sulphur present, which have been formed from the iron pyrites present in the coal and coke consumed as fuel; and my reason for considering that it is the sulphur dioxide in the air, rather than the sulphur compounds which are present to a slightly larger extent in the products of gas combustion, are as follows: All observers have taken great trouble to prove that it is the leather on the upper shelves of a library which become the most affected, and whilst the gas is burnt in the room, these upper shelves are exposed to the air, which has the power of taking up something like 60 per cent. more moisture than the air in the lower portion, and, at the high temperature which exists, this results in the drying of the leather. When the gas in such a room is extinguished, the temperature in the upper portion of the room begins to fall. But diffusion and other processes of ventilation remove the products of combustion long before the condensing point of the water is reached; and, within 20 minutes of putting out the gas, the sulphur compounds will have fallen down to the normal quantity found in the atmosphere outside the room, whilst the air, owing to contact with the warm walls, ceiling and the furniture in the room, will still be far away from the condensing point of the water vapor. As the air becomes colder and colder, and gets nearly to the point of saturation, the leather begins to absorb rapidly the same amount of moisture which it had previously given up to the air under the influence of heat; and with this moisture, it also absorbs traces of sulphur dioxide which all our town air possesses. In my opinion, it is chiefly *this*, and not the sulphur dioxide from the sulphur compounds in the gas alone, which brings about the deleterious results; and it will be found, in any room in which the air is kept artificially heated for a certain period in the day, and is then allowed to cool down again, this same destruction of leather will ensue—whether or not gas be used as an illuminant in the room—and though sulphuric acid may do its share in bringing about this destruction, the alternate moistening and drying will do far more.

It has also been considered a proof of the formation of sulphuric acid from the products of combustion of gas containing sulphur compounds, that dust collected in a room in which such gas is being burnt contains small quantities of sulphates. But here again several important factors of error have been overlooked. The dust which is found in a room has not been formed in that room, but has filtered in from the outside air under the sashes and other openings; and it must of necessity contain sulphur compounds, which have been produced by the fixation of the sulphur compounds produced by the burning of coal and coke, and by the ammonia and other alkaline bases present in the air. An analysis of dust from rooms in which no gas has been burnt will also show the presence of these bodies in as large quantities as from the rooms in which gas has been consumed in very considerable volume. Dust collected in my study at Greenwich, in which gas is very freely burnt, gave 3.05 per cent. of sulphur as sulphates; while dust collected in an attic of a disused portion of the same building, in which there has never been a gas fitting, gave 4.4 per cent. This mistake has been caused by the fact that rain washed dust collected on exposed outside sills often contains only a small percentage of sulphur. The closeness and oppressive feeling which can be distinguished in a room not properly ventilated when gas is being burnt, is not due to the presence of sulphur compounds, but to carbon dioxide and to the traces of the products of incomplete combustion. It is also partly owing to the organic emanations from the bodies and lungs of the inhabitants of such a room being unable to rise into the zone of highly-heated air which exists above the gas burners in the room, and so being kept down to the level from which the air for respiration is being drawn.

From the foregoing considerations I am very decidedly of opinion that the sulphur compounds given off from gas containing 30 grains of sulphur per 100 cubic feet, would be so infinitesimally greater than the traces obtained by burning gas containing 20 grains per 100 cubic feet, that it would be impossible to detect any difference in the action upon furniture and draperies exposed to it; while all the reliable evidence goes to show that minute traces of such oxides of sulphur have no deleterious effect upon the health. My desire this morning, however, is not so much to dwell upon the sanitary aspects of ventilation, as upon the effect of want of ventilation upon the light emitted by flames.

In 1835 Wehrle, in a paper upon the conditions necessary for the combustion of a candle, made some observations upon the effect of vitiation and removal of oxygen from the atmosphere upon the burning of the candle; but he gave no details as to the effect upon its photometric value. Twenty-five years ago, Dr. Angus Smith, however, whilst experimenting upon the combustion of candles in badly ventilated places, made a series of observations of the effect of vitiation upon the photometric value, from which he came to the conclusion that the removal of oxygen during combustion, and the increase of carbon dioxide in the air seriously affect the light emitted, and also that the effect of the vapor of water in preventing combustion and lowering the illuminating value is very great.

On Nov. 14, 1889, Mr. John Methven read a paper before the Southern District Gas Association on "Photometry," which was not only remarkable for its intrinsic merit, but also for the large number of new points which it suggested in this important field of research. Among the many valuable questions dealt with in this paper, was the effect of atmospheric moisture upon the illuminating value of flame; and the fact that the smaller and feebler the flame, the greater was the loss of luminosity due to this cause. Mr. Methven, in a lengthy series of experiments, and with the temperature practically constant, found that candles gave, per 120 grains of sperm consumed, a light equal to 1.104 candles, as compared with a light of constant power—Methven screen; and that this was increased to 1.196 candles, when the air in which the candles were burning was dried. This difference in the light value he considered to be due entirely to the removal of moisture, as the temperature remained the same. He also found that, when air saturated with moisture at increasing temperatures is supplied to a flame, the light-value is rapidly diminished, so that between the temperatures of 50° and 75° F., a diminution of 10 per cent. takes place in the light emitted by an argand flame burning 5 cubic feet of gas per hour; whilst with a flat flame, a reduction of 11.2 per cent. occurred, and with a gas flame from a 2 candle burner a loss of 13 per cent. was found within the same range of temperature. The greater loss observed with the flat flame and the small jet, Mr. Methven ascribes to the power of the different flames to battle with the aqueous vapor. These experiments were made by passing air from a gasholder through a leaden chamber over the surface of sulphuric acid, to dry it; whilst to saturate it, the sulphuric acid was replaced by water. At the end of the chamber was an upright tower, on the top of which the flame was burning—surrounded in the case of the 2 candle burner by a lamp chimney, and in the case of the flat flame by a glass globe.

During the summer of last year, I made a large number of experiments with the view of, if possible, finding out the extent to which the variations in the quantity of water vapor present in the air of a testing station would be likely to affect the value ascribed to the gas; and as it seems probable that the standard candle may soon be replaced by Mr. Dibdin's 10 candle "pentane argand," standardized from Mr. Harcourt's 1-candle pentane air gas unit, I directed my experiments to attempt to ascertain the effect of humidity upon these flames and upon the flame given by burning ordinary coal gas at the rate of 5 cubic feet per hour from the standard London argand. My earlier experiments were made by surrounding the flames to be tested by cylinders to which the air supply had to pass through trays of drying or moistening material; but I soon found that, unless special precautions were taken, variations were caused in the rate at which the air was supplied to the flame, whilst with any cylinders obtainable the rise in temperature due to the heating effects of the larger flame were sufficient to entirely upset the results.

With a view of as far as possible eliminating these disturbing factors an open bar photometer was fitted with the burners and disc 14 inches above the level of the table, and cylinders of thin glass, 12 inches in diameter and 24 inches high, were specially made by Messrs. Powell. The tubes carrying the burners rose straight from the photometer table, and were provided with sliding collars with four arms, to support the glass cylinders. Flat perforated zinc boxes were made to fit in the cylinders exactly an inch in depth, and were surrounded with soft felt, so as to prevent any air passing up between the cylinder and box. These

boxes, having been completely filled with wet or dry pumice or calcic chloride, as the case might be—the material having been previously sifted to pass through a three eighths inch mesh, but not a one-eighth—will each give very nearly the same amount of obstruction to the passage of the air; whilst, to prevent the air entering the top of the cylinder, and to quickly remove the products of combustion, a zinc plate was fitted over each cylinder, with a 2 inch tube with a funnel-mouth descending to within a short distance of the top of the flame. With this apparatus a long series of observations were made, to ascertain if the idea that the small flame is more affected by moisture than the more powerful one was borne out by comparative experiments; and, in order to do this, both the one candle unit and the large flame were surrounded with cylinders, and burnt under similar conditions—*i. e.*, in one set of readings each flame would have the air supply passing through dry pumice to give the normal results, whilst for dry and wet both flames would have discs of wet pumice or calcic chloride at the base of the cylinders. The results agree with those obtained by Mr. Methven, and seem to prove that excessive moisture in the atmosphere supplied to the flames, by affecting the small flame more than the large, causes the gas to read high; whilst dry air, by allowing the small flame to do its best, causes a slight diminution in the recorded illuminating value.

The facts which appeared to throw most doubt on the power of a small addition to the atmospheric moisture making a large difference to the luminosity of a flame are as follows:

(1) Mr. Vernon Harcourt made a long series of experiments, extending over several months, in which the one-candle pentane unit was tested against an electrical standard, in order to ascertain the effect of the height of the barometer upon the light emitted by the flame. During this long period no variations were observed which led Mr. Harcourt to suspect that humidity had any influence on the amount of light emitted, although there must have been considerable changes in the quantity of moisture present.

(2) When the action of moisture on flame was first pointed out, Mr. Greville Williams, F.R.S.. and Mr. W. C. Young each made independent experiments, by testing the gas against candles during one portion of the day with the air in its normal condition, and then watering the floor of the testing room and taking another series of tests. Neither of them was able to detect any difference in the value ascribed to the gas by the candles.

(3) It seems inconceivable that, with the large proportion of water vapor already present in the flame as a product of combustion, the small additional quantity present in the air should make so large a difference.

(4) In making the experiment described above, it was observed that the temperatures in the cylinders were uniformly higher when dry air was passing than with the experiments with wet or normal air; and these differences were far greater than could possibly be explained by any absorption of heat by water vapor.

With a 15 to 16 candle flame the temperatures were: Normal, 91.60° F.; wet, 86.1° F.; dry, 105.69° F. With the 10 candle flame they were: Normal, 87° F.; wet, 85.8° F.; dry, 97.5° F.

It was naturally felt that the increase in illuminating value of the dried air was probably due to this increase in the temperature of the air in which the flame was burning—the effect of temperature upon luminosity being well known. Mr. Harcourt suggested that the reason of the increase in temperature was that the calcic chloride became to some extent broken up, thus forming a closer layer and retarding the flow of air. I could not conceive this being the cause, as all the material used in the discs being of the same size, and no shaking taking place which would be likely to break up the calcic chloride, it seems most probable that, if any interference took place, it would be in the moistened pumice, as water would to a certain extent close the pores of the material. The fact of the difference in temperature, however, remained, and was quite sufficient to throw grave doubts upon the results.

In order to ascertain if there was any difference in the rate of passage of the air through the cylinder, a delicate anemometer was obtained, and its readings were corrected by a known flow of air. The tube carrying off the products of combustion was then elongated, so as to bring the temperature of the escaping gases down to a little over 100° C., and the anemometer fitted in the mouth of the tube; discs containing dry and wet pumice and calcic chloride respectively being employed at the bottom of the cylinders, as in the previous experiments. The standard pentane argands were used as the sources of light—the value of the one burning in the open air being given in terms of the one in the cylinder—and the experiments showed precisely the same class of results as in the previous long series; and at the same time it was found that the flow of air was practically identical in each case.

The next question that presents itself is, Does the difference in the temperature observed, from whatever cause arising, make the difference observed in the illuminating value? The only way to try this was to make the experimental chamber so large that the heating of the walls would not vary to any great extent, and the temperature, therefore, would remain fairly constant. In order to do this a zinc chamber, 3 ft. 6 in. by 3 ft. 6 in. by 4 ft., was constructed at one end of the photometer bar, with a glass window of carefully flatted thin sheet glass cemented in gas-tight on the side next the disc, and a door having a small window, and closing practically gas-tight, on the opposite side. The burner was arranged at the center of the chamber, so that half the chamber overlapped the bar; and a ventilating tube 3 inches in diameter, with a funnel opening, came down through the roof to a few inches above the flame. Openings, closed with india-rubber corks, were arranged at the bottom and at intervals up the sides, in order to admit thermometers, and two false bottoms of perforated zinc were placed in the bottom of the chamber, to ensure an even distribution of the entering air. A 10-candle pentane argand was fixed in the center of the chamber, and was compared in the following experiments with a second one fixed at the other end of the bar. The burner in the chamber was allowed to burn coal gas all night, with the door and all the openings of the chamber open, so as to get an even temperature; and in the morning, the pentane argand having been supplied with carbureted air, the door was closed and the bottom air inlets left open, and a normal test was taken. Saturated cloths were then hung in the chamber; and, as soon as the wet and the dry bulb thermometers showed the air to have become highly charged with moisture, the wet readings were taken. These experiments conclusively proved that, in the former set as in these, the rate of flow and the temperatures in the cylinders have practically nothing to do with the effect of the moisture of the air upon the luminosity of the flame; and that the variation in the temperature in the cylinders was in reality due to the variation in the temperature of the flame, caused by the cooling action of the water vapor upon it.

In order to prove, if possible, that this is the case, I made a small thermo-couple of platinum, and platinum with 10 per cent. of rhodium wire; using it as thin as possible, to reduce errors from loss of heat by conduction, and keeping the wires of considerable length, to prevent any chance of a rise of temperature introducing conflicting currents at connections with the galvanometer wires. A reflecting galvanometer was employed, and sufficient resistance—50 ohms—introduced into the circuit to keep the spot of light upon the scale at the highest temperature of the flame. The scale was then graduated for temperature, by taking water at 0° C. and 100° C., and checking the higher temperatures by the fusing points of the chlorides of the alkalies and alkaline earths, as determined by Dr. Carnelly. The thermo couple was attached firmly to the base of the 1-candle unit, and the junction was inserted at the tip of the non-luminous zone of the flame, so as to avoid the deposition of carbon, which would alter the temperature to a slight extent. The top of the inner cone is far from being the hottest part of the flame, but it will vary in temperature with the rest of the flame, although probably not to so great an extent. Working in this way, with the flame in a partly dry and saturated atmosphere, the following values were ascribed to a 10 candle standard, burning in the open air at the other end of the bar—

	Dry.	Wet.
	9.9	10.6
	9.9	10.6
	10.0	10.6
	10.0	10.6
	9.7	10.6
	10.0	10.5
	10.0	10.4
	10.3	10.5
	10.0	10.6
	10.0	10.8
	9.99	10.58
Temperature of the flame at the top of the non-luminous zone	1,022° C.	903° C.
Grains of moisture per cubic foot of air.	4.9	6.6
Degree of saturation	42	88
Temperature in cylinder.....	82° F.	68° F.

This experiment makes the cause of the diminution in light of the pentane unit perfectly clear, as an increase of 1.7 grains of moisture makes a difference of 119° C. in the temperature of the flame, and a consequent loss in its power of emitting light. In order to satisfy myself that there was no error, the temperature of the pentane unit was taken at the same spot, when burning in normal air; and it gave as a

result 932° C.—there being present 5.2 grains per cubic foot of air, and a degree of saturation equal to 65° C.

The next experiments made were to determine the alterations in temperature taking place in the 10-candle standard pentane argand flame, with alterations in the humidity of the atmosphere. To do this, the thermo-couple was, as before, fixed to the burners, so that it could not move, and throughout the experiments the flame was kept at a constant height—the twist of the platinum and platinum-rhodium wires being plunged into the flame just below the point at which it became luminous, so as to avoid deposition of carbon upon it. In order to prevent any possibility of change in position of the wire, the burner was fitted with the cylinder and a disc of dry pumice so as to first obtain the normal results. Water was then freely sprinkled on the disc, in order to saturate the air for the "wet" readings: and, after allowing this moisture to evaporate as far as it would, a layer of calcic chloride—coarse—an inch in depth, was placed on the surface of the disc to dry the air. The anemometer readings show the result was not influenced by the rate of flow of air through the apparatus, which was practically identical in each case.

	Wet.	Normal.	Dry.
Temperature of flame	1,376° C.	1,395° C.	1,449° C.
Anemometer reading.....	401	401	405
Temperature of products of combustion	100° C.	101° C.	105° C.
Dry bulb	67° F.	68° F.	83° F.
Wet bulb	65° F.	64° F.	69° F.
Degree of humidity.....	88	78	45
Grains of water per cu. ft..	6.40	5.80	5.40
Percentage of water vapor.	1.81	1.64	1.53

In this set of experiments a difference of 82° C. has been produced in the temperature of the flame by an increase of 1 grain of moisture per cubic foot of air, or an increase of 43° in the degree of humidity; while with the 1 candle unit in the previous experiments a difference of 1.7 grains in the amount of water vapor present gave a variation of 119° C. in the temperature, or 70° C. for each grain.

Mr. Methven, in his admirable paper, attributes the greater loss of light which the small flame undergoes in comparison with the larger flame to the superior power which the latter has of battling with the moisture; but I think the more probable explanation is to be found in the fact that a reduction in temperature between 1,300° and 1,400° C. makes far less difference to the light emitted by the incandescent matter in the flame, than the same difference taking place between 1,000° and 900° C. From these experiments, I have no doubt but that the result is caused by the cooling of the flame, due to increase in the humidity of the air; but it has now to be decided whether it is alteration in the degree of humidity—*i. e.*, in the amount of saturation—or absolute quantity of aqueous vapor present which brings this about.

In the large number of tests which I have made, there have been some which could only be explained on the supposition that it was the degree of saturation which was the active agent, and not the amount of water vapor present. Such examples are of fairly frequent occurrence; and the two following sets of experiments, made with an ordinary coal gas flame, burning at the rate of 5 cubic feet per hour, from a "London" argand, under varying conditions against a 10-candle standard, show this:

Readings of Gas Flame in Cylinder against Normal Ten-Candle Pentane Argand.

	A.	B.	C.
	13.10	12.30	13.60
	13.10	12.20	14.00
	13.10	12.00	13.90
	12.90	12.20	14.10
	12.80	12.10	14.00
	13.10	12.30	13.60
	12.80	12.00	13.60
	12.60	12.00	13.60
	12.90	12.10	13.90
	12.80	12.10	13.70
	12.92	12.13	13.80
Rate of flow of gas.....	5 c. f.	5 c. f.	5 c. f.
Temperature in cylinder—wet bulb	63° F.	64° F.	68° F.
" " dry bulb	70° F.	64° F.	81° F.
Grains of moisture per cubic foot.	5.2	6.6	5.4
Degree of saturation.....	65	100	47

Here there is an increase of 0.8 candle in the light emitted by the flame in cylinder C over A, though there is 0.2 grain of moisture per cubic foot of air more in C than in A; but the degree of saturation is 18° less in C than in A.

Another experiment of the same kind gave—

	A.	B.	C.
	12.30	11.40	12.70
	12.30	11.40	12.80
	12.10	11.10	12.50
	11.90	11.10	12.80
	11.80	11.10	12 70
	12.40	11.00	12.60
	12.00	11.10	12.60
	11.90	11.10	12.60
	11.70	10.80	12.70
	11.90	11 20	12 90
	12.03	11.13	12.69
Rate of flow of gas.....	5 c. f.	5 c. f.	5 c. f.
Temperature in cylinder—wet bulb	58° F.	61° F.	63° F.
" " dry bulb	66° F.	63° F.	75° F.
Grains of moisture per cubic foot.	4.2	5.6	4 6
Degree of saturation.....	60	88	49

These tests, I think, show conclusively that it is the degree of saturation of the atmosphere, and not the actual amount of water vapor per cubic foot of air, which acts in this powerful manner upon the temperature, and therefore upon the light that is emitted by the flame. When the degree of saturation is low, the large amount of water vapor produced by the flame rapidly diffuses, and is taken up by the air; and hence the withdrawal from the flame is more rapid than when the air is nearly saturated. And in the latter case, the large quantity of water vapor remaining longer in the flame, cools it partly by physical and partly by chemical action. On analyzing the gases at the extreme edge of the flame, the water vapor is found to vary from 14 to 15 per cent. by volume near the base, where the hydrogen and methane of the gas have rapidly diffused to the exterior—and are, therefore, the principal gases entering into combustion—to 11 per cent. near the top of the flame. The water vapor in the atmosphere is, on the average, 1.5 per cent. by volume; and at temperatures below 70° F. it rarely, if ever, exceeds 2 per cent.

At the high temperatures existing in the cylinders during the experiments on the effect of humidity upon the light emitted by the 10 candle pentane argand, the variation was from about 1.8 per cent. by volume in the dry cylinder to 2.4 per cent. in the wet; and it seems absurd to suppose that a difference of 0.6 per cent. by volume, or 2.3 grains by weight, should make the large difference observed in the illuminating value of the flame. If, however, it is the degree of saturation which is the active factor, we at once find the explanation of the effect, as the degree of saturation in the dry cylinder averages 33°; whilst in the wet, it rises to 66°—a difference of 33 per cent. The effect being due to the degree of saturation also explains the fact that the action of humidity has not been before observed during the daily testing of the illuminating power of the gas; as, although the variation in the amount of moisture present in the atmosphere is very great between winter and summer, yet the degree of saturation does not vary to anything like the same extent. Moreover, the moisture present in the outside air in no wise represents the moisture present in the testing-stations kept at carefully regulated temperatures. I think it would be found that, if the temperature could be kept within a narrow range—say between 60 and 66 F.—the trouble would practically disappear, except under the most abnormal conditions.

I have kept a record of the degree of saturation of the atmosphere in my testing room at Guildhall Chambers during the two autumn and two winter months; and find that the degree of percentage of humidity only varies within a narrow range. The average for August and September was 74.5, whilst for November and December it was 75.1; and nearly the whole of the determinations fall between 70 and 85°. The test-room at Guildhall Chambers has no ventilation or proper means of keeping a constant temperature; and I should expect, in a station having these advantages, the readings would be still more constant. Accepting the variation at from 70° to 85° of humidity as the average range in a testing station, it is interesting to see how this would affect the light emitted by the various burners; and, in order to satisfactorily settle this point, the following experiments were made, by testing the 1 candle flame and the 10-candle pentane argand separately against as nearly as possible constant standards, whilst the two flames being tested are subjected to known variation in humidity. On doing this, the following results were obtained as the mean of a large number of observations:

One-Candle Unit.	Normal.	Wet.	Dry.
Percentage of saturation	75.60	93 50	45.70
Grains of moisture per cubic foot	5.53	6.30	4.06
Illuminating power in candles	0 932	0 874	1.0332
Ten-Candle Unit.			
Percentage of saturation	66.50	76.00	37.00
Grains of moisture per cubic foot	7.10	7.60	5.60
Illuminating power in candles	9.81	9.53	10.30

And it is evident from this that the maximum variation of 15 per cent. in the humidity of the air of a testing station would only cause a variation of about 2 per cent. in the value ascribed to the larger flame by the 1-candle unit.

The question has been raised as to whether, in view of the action of humidity upon flames of different size and character, it would not be better to test the illuminating value of gas against a standard more nearly approaching the value of the flame to be tested than by the 10 candle pentane argand. To decide this point, I have made a long series of observations, in which the value of a coal-gas flame, burning at the rate of 5 cubic feet an hour in a standard London argand, under normal wet and dry conditions of the atmosphere, is expressed in terms of a 10-candle pentane argand burning under normal conditions.

The following are the mean of 330 observations:

	Normal.	Wet.	Dry.
Illuminating value of the flame in candles	16.98	16.18	17.30
Percentage of saturation of the air	56.00	87.60	46.80
Grains of water per cubic foot of air	6.18	7.08	6.06

Showing a variation of 7 per cent. in the illuminating value of the flame for a difference of 40.8° in the percentage of saturation, or 1.7 per cent. for 10°.

It is now possible to tabulate the effect of the percentage of humidity upon the various flames as follows:

An increase of 10° in the percentage of saturation of the air causes a diminution of—

3.3 per cent. in the light of the 1 candle unit.
2.0 " " 10 candle argand.
1.7 " " 16 to 17-candle flame.

This means that the extreme variation of 15° likely to occur in the humidity of the atmosphere in a testing-station might cause a variation of 0.45 per cent. in the light credited to the gas flame by the 10-candle pentane argand, which would amount to 0.07 of a candle.

Important as these considerations are in relation to gas testing, it is manifest that moisture present is not likely to cause any serious loss in the illuminating value of gas as burnt in a room, as in the heated zone in which the gas is burning, the degree of saturation will be considerably below that existing in the original air, although the absolute amount of water vapor present will be higher. At the same time, however, another factor begins to come into play which does exert a serious influence upon the flame; and that is the carbon dioxide produced as a product of combustion and the consequent diminution to a minute degree of the oxygen present in the atmosphere.

Taking the flat flame gas-burners of the domestic sizes—*i. e.*, Nos. 4 and 5—it will be found that, when the carbon dioxide has risen, as it generally does rise, in the upper zone of the room to 0.4 per cent., the illuminating value of the flame will have been diminished by nearly 12 per cent.; and the effect upon the argand seems to be nearly as great. These results show us that, important as good ventilation is for the health of the human being, it is equally important to the illuminant itself; and that we must look upon all improvements in ventilating burners as important steps, not only in popularizing the use of coal gas, but also as improvements in the amount of light to be obtained from gas. In making such improvements, I would strongly urge upon the gas engineer the importance of discarding metal pipes for carrying off his products of combustion; as, although the sulphur present in the coal gas makes practically no difference to the health and furniture in a room, whether it contains 20 or 30 grains per 100 cubic feet, yet as soon as the products come to be cooled down in the tube which is leading them away, the condensation of water vapor at once means the production of small quantities of sulphuric acid, which rapidly attacks metal tubes, and by eating them away becomes an active source of danger where such tubes are led for any considerable distance through the floor spaces.

In concluding this lecture, I venture to hope that I have been able to awaken some fresh thoughts in your minds upon a somewhat hackneyed subject, and also to give experimental data which, in practical hands, may be made to bear fruit.

The Flash Point and Point of Danger of Mineral Oils.

The danger of fire or explosion from a mineral oil is tested, says D. R. Steuart, F.I.C., by taking its flashing point. The Government test (English) of Prof. Abel is a 2-inch cup covered on the top. The filling, heating, light applied, etc., are all defined. Holes are opened in the lid for a moment to apply the light at specified intervals, and the point got is very definite. The question is: What relation has the point so got to the point of danger? Is the Abel flash point itself the point of danger, or is danger to be feared only at a much higher temperature?

Before a Parliamentary committee some years ago, a witness said there was no danger at all unedr the temperature of the American fire test. The flash point is the lowest temperature at which the vapors and air give a little explosion when the light is applied, going instantly out. The fire point is the lowest temperature at which the vapors burn continuously.

A particular sample of oil I tested flashed in Abel test at 78° F., in the old Government open test at 105°, and fired in the old Government open test apparatus at 122°. This last is something like the American fire test. Is there, with this oil, no danger of fire in a store or explosion in a lamp until about 120° F. is reached?

A moment's thought will satisfy us that although a little cup of oil cannot supply sufficient vapor to keep up a constant flame until 122° F. is reached, a larger surface will supply vapor, and, when ignited, heat enough to produce a constant flame at a much lower temperature. I tried the oil mentioned above in an apparatus like the old Government open test, with screen around and partly also on the top, but 9 inches in diameter. Applying a small flame every 2° at a half-inch above the surface, the oil ignited explosively at 88°, and continued to burn furiously. Repeating the experiment, and applying the flame at every degree, it ignited and burned continuously at 87°, and the flame rapidly increased in vigor. Making the same apparatus a close test like Abel's, the oil ignited and fired (burned continuously) at 76° F.; that is, with a 9-inch wide closed test, instead of the 2 inch prescribed by Act of Parliament, the oil not only flashed but fired 2° below the flash point in Abel's test, and when open it fired only 9° above the Abel test. With a wider surface of oil, the flashing and firing would no doubt take place at even a lower temperature. These experiments prove, if they require proving at this time of day, that the old Government open test and the American fire test are altogether deceptive, and that in store, barrel or tin can, the flash point, Abel test, is a point of real danger, and that for oil in large masses the danger begins even below the flash point (Abel). The experiments also prove that, except for very small surfaces of oil, the flash point and the fire point are the same.

The following happened in my experience:

A large tank of very high flashing oil was being pumped into, and the oil therefore in considerable commotion. The temperature was far below the flash point in Abel cup; nevertheless, vapors were evolved and filled the top of the tank, and expelled by the rising oil, overflowed out at a manhole door on the top, which was not quite close, and ignited at a lamp some distance below. The fire ran up the stream of vapor; there was an explosion, blowing off the top of the tank, and the oil caught fire and burned uncontrollably until it was practically all consumed. For danger in oil works, even the Abel flash point is deceptively high. Is it because this has not been realized that fires in oil works have been so frequent?

In regard to danger in a lamp, in 1872, before a select Parliamentary committee, a chemical expert said: "We have made a great number of experiments to ascertain whether oils which flash at 100° (equivalent to 73° Abel test), or even a little below 100°, can by any contrivance be exploded in a lamp, and we cannot do it, whether by electric spark or flame of any kind; but we cannot fire it—that we have ascertained to be a fact." Now, the real fact is that a lamp filled with oil of 100° old open test, if shaken up—as by carrying the lamp—can be exploded with electric spark quite easily, even at 73°. The explosion is not violent; but at 5° above the flash point (Abel) the explosion may be very violent. Such an oil can explode violently at any temperature between 78° and 120°; that is, at all temperatures lamps are generally exposed to. For lamps burning heat up the oil, more with large lamps than with small, more with metal lamps than with porcelain, more if with metal safety tubes than without, and more with flat burners than with central draught. As all ordinary lamps are more than 2 inches wide, the flash point in them will be the Abel flash point, or a little lower. There is a little danger even at the Abel flash point, for although the explosion at that temperature is a mere puff, yet if it happened while the lamp was being carried it might cause it to be thrown down on combustible material. At any rate, at 5° above the Abel flash point the danger is very great.

I have tried many experiments oversetting cheap gas lamps when burning, so as to break them. I had the lamp half filled with oil and heated to certain definite temperatures. At 5° above the flash point (Abel) all in general went out. At 10° above flash point, with some, low-flashing (73° to 78°) petroleum ignited and burned vigorously, and some merely flashed and went out. High-flashing oils (100° to 110, Abel) 10° above flash point invariably went out or merely flashed; they never permanently ignited. At 15° above the flash point the high-flashing oils inflamed, but burned quietly, and the fire could easily have been commanded. So low flashing oils may be a great danger if overset at 10° above flash point; but high flashing oils are not in great danger until 15° over flash point or more; that is, if overset on an ordinary floor. If overset on easily combustible materials, there is great danger, even at the flash point, and as the absence of combustible materials can not be depended on, even for this kind of accident, the flash point (Abel) becomes the point of danger. If an open cup of oil heated to the flash point (Abel) has a large lighted candle plunged into it, the candle is extinguished just as by water. These experiments show the freedom from danger in lamp, or in any small quantities, and particularly of high flashing oil, if kept several degrees under the Abel flash point.

High flashing oils burn practically as coolly as low flashing oils, and if we seek safety by using a high flashing oil we are not running into any other danger.

Coroner's inquests are very frequently on lamp accidents. It has become the custom for the inspectors to state that no dangerous oil is now imported into England, and inspector and coroner put the whole blame on the lamp. But surely no scientific man is free to state that 73° flashing oil is safe in our climate. It is often 80° or over it in houses, and all the year round the temperature in ordinary lamps is 80° to 90°. The danger is not a mere matter of opinion, but an easily ascertainable scientific fact; and when a scientific man makes such a statement regarding a matter involving hundreds of deaths in England every year, I think he should somehow be amenable to the ban of the profession, if to nothing else. It is absurd to blame the poor for not having safety lamps; besides, even if they had them, they are only an extra source of danger, unless in proper order, and with cheap lamps and ignorant people that could not be depended on.

It is obvious to common sense that the poor should be supplied with oil, such as the rich supply themselves with, safe to work with at ordinary temperatures and perfectly safe from danger of explosion in ordinary lamps properly attended to. With ordinary petroleum there are many real lamp explosions, in spite of all that is said to the contrary. Carry the lamp about, attempt to blow it out, or turn down the wick too far, and the lamp explodes. These could never happen with an oil whose flash is a few degrees above the temperature of the oil in the lamp. Lamp fatalities are so dreadful that one would think that a few would waken up the people so as to get the matter put right; but the deadly tale goes on day by day, but it is among the very poor, and nobody seems to care. The Government, contrary to the example of all other civilized countries, has given what is practically a certificate of safety for oils flashing above 73°, and, instead of protecting us, has, by legislation, shut itself out from the power of interfering. So these dangerous oils can be stored in any quantity anywhere. Store proprietors and railway companies exercise great care; nevertheless, our lives are at the mercy of the idiosyncracy of individuals, and we may expect a catastrophe on the grand scale some day.

In the past, nobody took any interest in the petroleum laws except the representatives of the oil trade. It is time scientific men, for the sake of the voiceless poor, should pay some attention to the matter. The science put before the Parlimentary committee was sometimes of a strange kind, and matters of fact were treated as matters of opinion instead of being settled by experiment. It is evident the Government does not know that the flash point (Abel) is in all cases a point of real danger, and in stores and tanks of great danger. They evidently think there is no danger under the temperature of the old open test. They would never have lowered the safety point from 100° to 73° if they had known that the old test was deceptive by that interval—and they ought to have known.

Oil vapors, when hot, as in the old open test, diffuse away pretty rapidly, but when cold, as in a store, they are very heavy, roll along to the lowest point, and if there are no air currents, diffuse away very slowly. They can be decanted from vessel to vessel like carbonic acid gas; but this the Government officials are ignorant of, and think that oil vapors diffuse rapidly into the atmosphere like coal gas.

At the annual meeting of the Welsbach Light Company, the following Directors were chosen: W. W. Gibbs, Thos. Dolan, Edward C. Lee, A. G. Ritchie, Randal Morgan, Samuel T. Bodine and W. E. Barrows.

Development of the Foundry in America the Past Thirty Years.

[A paper read by Mr. William Ferguson at the June meeting of the Western Foundryman's Association.]

As this is too broad a subject for anyone to attempt to cover with much satisfaction in one short paper, therefore I will not deal with details to any great extent.

One often hears the remark that there has been less advancement in the foundry than in any of the other departments of engineering. Judging from the same standpoint as the other departments are measured from—viz., special machinery—this may be true. But from a purely mechanical standpoint the facts in the case show that the foundry has developed as rapidly and as thoroughly as the other departments, and has met all requirements put upon it; and while doing this it is surprising to think how well it has met these requirements in the face of such opposition as it has had to contend with, coming from those who should be most interested in its success. Is it not an acknowledged fact that the foundry has been the most neglected department in the majority of engineering plants in this country? And it is only of very recent years that manufacturers have begun to realize that this department was deserving of some attention. For this change much credit is due to those who, having the knowledge and ability to do so, spared no pains in putting their experience and knowledge before the world in the shape of books and articles in mechanical papers bearing on the subject of foundry practice. These writings have not only helped to educate the molder in his business, but have set manufacturers to thinking that the foundry required some of their attention, and was not altogether the miserable and dirty place they had supposed it was.

And truly it must be said that the standing of the moulder and his business 30 years ago was not an enjoyable one; and along with this the general impression prevailed that it was a business to be taken up by those only below the average in intellect, and not very bright. As an illustration of this, I remember an incident that occurred about 30 years ago. A young man just from the farm applied for a position to learn the machinist's trade, and his uncle, who was manager, after looking the young man over, expressed the belief that he would not make a machinist, as he "did not look overly bright," but that he might do well enough to make a moulder. So the young man was put in the foundry, and to his credit, it must be said, he made a decided success.

With the rapid development of this country after the late war came the growth and development of the iron business, and each succeeding year found the manufacturer enlarging his plant to meet requirements. In those days it was unusual to cast daily. Some of the largest plants were satisfied with three heats per week, and each heat perhaps would not exceed three to four tons. Coke at this time was just being introduced as a substitute for Lehigh coal to melt with, and there was not the varied number of different brands of pig iron, nor of as good quality as we have at this present time.

And while there were good moulders in those days, they were not taxed as to quality and quantity as they are to day, through keen competition; and the good moulder of those days was sure to be a privileged as well as a bibulous character, and was quite likely to go on a spree just as he knew his services were about to be required, on some special job. While this is not altogether wiped out, it is fast going, and it is rarely we see such cases now. We cannot speak of the foundry now without making mention of the moulder, therefore you will pardon me for identifying him with the progress of the foundry.

Along with the enlarging of plants came the development of the foundry, and the requirements of the moulder were taxed accordingly. Small plants were forced to take large contracts far beyond their capacity to fill, and in such cases the energy and ability of the foundryman were called upon to meet these requirements, and with varied degrees of success, until said contracts were complete. The foundryman with a 30-inch cupola would be called upon to make a 4 or 5-ton casting, with possibly a 3 ton crane to handle it. If he would ask for a larger cupola or stronger crane, he would be told that was out of the question. "We have not figured on the extra expense while taking the contract, and we must now make it with such appliances as we have." Then came the anxiety of the foundryman, planning and making with nothing suitable to do the work, but finally succeeding in getting what he considers a good, safe mould ready to be filled. The cupola is got ready with special care, and charged so as to do its best possible melting, for the final success now depends on this part of the business. But when everything possible has been done, we then can see it is going to be too much for the small cupola to do. No one but the foundryman who

has been there can tell the mental strain that takes place with all this cast of moulding and melting to be finally lost, simply for lack of proper tools to do the required work. Still, in these cases the loss was usually charged to the foundryman not understanding his business, when the fact is, as I have stated, it is chargeable to lack of proper facilities.

And in most cases this same thing had to be repeated more than once before the parties interested would conclude to increase their facilities, and this they were most always sure to do only to meet the present requirements, with the result that they would in a short time again find themselves in the same condition as before.

Such has been the history of development in the foundry, and most men who have been engaged in this business for any length of time know that they have paid well for their experience in this way. It has been noticeable also that where the facilities were about equal to the requirements, the foundry was usually as free from loss as other departments. And by this admission we have arrived at a point where we must allow that to get good results and work from a foundry with the greatest economy, it must be done with proper equipment.

Manufacturers are each year becoming more alive to the real cause of bad work and excessive cost, and, as a result, are spending more time and money to equip their foundries; but still there is plenty of room for improvement. In former years it was the pride of the manufacturer, in showing visitors through his plant, to take them through the machine shop and pattern shop, showing everything in detail; but when they came to the foundry he would pass it by as though it was not a part of his institution. Not so with the modern foundry, with its electric and hydraulic cranes, moulding machines and patent cupolas. It proves to be as interesting as the other departments, and there is a correspondingly brighter future ahead for the foundry and the moulder. And each year adds greater proof that brains are not only needed, but are used to a greater extent in this part of engineering than most men are free to admit. The day is not far distant when the work of the founder will have the rank and standing in the mechanical world to which it is so justly entitled.

Activity in the New River Coal Field, West Virginia.

Mr. Edmund C. Pechin, in an article in the *American Manufacturer*, says: Until recently, the mining of coal on New River, West Virginia (Chesapeake and Ohio Railway), was confined to the north side of the river. The seams of coal, Nutall, Fire Creek and Quinnimont are high up on the hills, and not very thick, running from 36 inches to 40 inches, and in some cases to 48 inches. Even a moderate output in a comparatively short time necessarily exhausts a large acreage, and much of the front coal has been worked out, compelling extensions of narrow gauge roads, in some instances of miles into the back country.

The defile of the New River is narrow, and the mountains rise sharply and ruggedly from the water's edge, making improvement and communication tedious and expensive.

Some few years since, the Chesapeake and Ohio Railway Company, built a substantial 3-span iron bridge across the New River from Thurmond station to near the mouth of Dun Loup Creek. Just west of Thurmond a slight recession of the high hills gave the opportunity for making, at a considerable expense, a good sized yard for the making up of coal trains. As this promises to become one of the most important shipping points on the whole line, this yard was indispensable, especially in view of the fact that all of the coal coming off of the branch now to be noticed, comes out ahead of the engine. This is of course a disadvantage, but the configuration of the ground on the south side was such that it could only be reached by a switch back from the bridge.

On this south bank of the river, and connected with the bridge, a branch has been built, running westwardly, and on this, five large mining operations have been established. Was told that this branch had been graded some 19.6 miles west from Dun Loup Creek, to opposite Fayette station. An additional five miles will bring it to Hawk's Nest. With this completed, the road will occupy and control both sides of the river for a distance of 25 miles, and make the entrance of any other road practically an impossibility. The south bank of the river and the Dun Loup Creek front are the keys to unnumbered acres underlaid with coal. The future coal supply of the Chesapeake and Ohio railway is now absolutely assured.

To the kind attention of Mr. J. J. Gordon, of Cincinnati, I am indebted for details, which clearly show what is doing in this locality.

It must be kept in mind that the coal seams on the south bank of the river are, as on the north side, high up on the hills, requiring inclines of varying length to get the coal to the railroad track, the coal dipping to the south and west.

The first mine, about one mile below the bridge (west), is that of the Thurman Coal Company, controlled by Mr. M. E. Miller and associates, of Staunton, Va., and from which Low Moon furnace draws its supply of coal, which is coked at the furnace.

The seam worked here is upper, locally known as the Nutall or Sewell, and is reported four and a half feet thick. Prof. I. C. White says that its true name is the Nutall, and this name will be adhered to in this paper. A mile further west is the Rush Run Coal Company, working the Fire Creek (a lower) seam; thickness about four and a half feet. No positive work has been done on the Nutall seam on this lease, but an exposed face of about five feet is reported.

One and a half miles further west, is the Red Ash Coal Company, also working the Fire Creek seam, with about four and a half feet of coal.

The Nutall has not been opened here. This is a new mine and has only been shipping coal for about four months.

Two miles further west is the Brooklyn Coal Company, on the Nutall seam of from 4½ to 5 feet, and shipping for the last 90 days. The Fire Creek seam on this lease does not show sufficient thickness to justify working.

Two miles further west is the Cunard Coal and Coke Company opening the Nutall seam, which here shows 4 feet. This colliery has not as yet made any shipments, but is about ready. It is reported that this is the only seam of any present commercial importance.

The four companies last named are controlled by Mr. I. F. Effinger and friends, of Staunton, and are practically the Rush Run enterprise, the stockholders, with some minor exceptions, being the same.

The road is not completed beyond the Cunard colliery. It is currently reported that about 2 miles west, Mr. Miller has a lease. It is supposed that this is for the New River Coal Company, which has about exhausted its territory on the north side of the river. The coal is the Nutall, about 4 feet thick. Nothing is being done here as yet.

Below and adjoining this lease is one reported to have been made by Wm. Berry Cooper & Co. This land is about opposite the Caperton works on the north side. The Nutall seam shows about 4 feet all through this territory. This boundary extends to or nearly opposite to Keeney's Creek, which is one of Nutall's operations on the main line. It is rumored that another lease has been made lower down, but as far as could be ascertained, the coal has not been opened up below Nutall's on the south side of the river. All of the above named leases are located on lands belonging to the late A. A. Lowe, of New York, and are worked on a royalty.

It will be seen that what has already been done on the river in connection with the building of a branch up Dun Loup Creek and the leases made by McKell, have radically strengthened the position of the Chesapeake and Ohio railroad as a great producer and carrier of both coal and coke, and while in the past it has done a large business, it now promises to shortly stand in the front rank as a great mineral carrier. It is safe to assume that these collieries, combined with the Dun Loup leases in operation, can give, if desired, a yearly coal tonnage of hard on to 1,500,000 tons.

I was particularly struck with the excellent and substantial character of the work at these new mines in the shape of inclines, tipples and buildings. It conclusively indicates that the operators have the fullest confidence both in the quality and quantity of their coal and are there to stay.

The dwellings at the Thurmond mine are on top of the mountain, there being no room at the base, and I did not get to them, but I was much gratified by the comfortable look of the miners' houses at the lower works visited. Instead of the rude, rough, unpainted shacks usually seen at mining camps, the cottages are large, well built and painted, presenting a most attractive appearance.

It is strange that employers are so slow to learn that scabby houses bring scabs, and that if good, reliable workmen with families are to be gotten and kept, some reasonable attention must be paid to their convenience and comfort. Good, cleanly dwellings mean good workmen, and good workmen mean good work, and good work, in the long run, means good profits.

Penny-in-the-Slot Meters.

The *Gas Fitter's Review* having called attention to an article on this subject in the columns of the Liverpool *Mercury*, goes on to say:

We have no hesitation in again bringing before the notice of the public the progress of the automatic prepayment gas meter. Since our last notice, which appeared in these columns about a year ago, these meters have multiplied and increased in the land exceedingly, and, moreover,

they have been so improved and remodeled as to make them as near perfection as possible. We wonder what Jerome would have to say with regard to the automatic meter. It was he who wrote, if we mistake not, that the spread of these automatic machines was calculated to increase moral depravity amongst all classes. His argument is rich in humor, and in the earlier stages of automatic machines containing cigarettes, sweetmeats, etc., when public curiosity rendered them objects of great interest, a humorist would not have to seek far before he found plenty of instances in support of such an argument.

After regretting the evil influences which the automatic machine had exerted on himself, Jerome declares that he is not by a long way the only man whose character is being thus automatically deteriorated by these "instruments of evil." He goes on: "The virtue of the nations is being drained into their capacious slots. Men come to me—men who, until a year or two ago, were honest, upright pewholders—and gloat as they tell me shameful tales of how they have palmed off French 'pennies' upon some unsuspecting sweetstuff machine, or how six of them had tried their weight for the price of one." He also alludes to the "meanness and frequent dishonesty of the machines," and argues that, in consequence of this, folks who might otherwise remain honest are compelled, in sheer self defence, to try and cheat the machines on every possible occasion, and thus, he says, "a general spirit of guile is fos tered through the land."

But even Jerome would be satisfied if he came across the latest of these automata—the prepayment gas meter. Improvement after improvement has been added to it, and now it would seem that the ambition of the inventor of what Jerome calls "soulless automata" has been attained, and the present form of meter can neither cheat nor be cheated, but, on the other hand, gives an unalterable receipt for every penny placed in it. Instead of dispensing guile throughout the land, it fulfills a much more laudable purpose, and enables the masses to enjoy the benefit of an illuminant which, owing to the fear of having to meet perhaps heavy quarterly bills, and inability to pay the deposit for the meter, has hitherto only been enjoyed by those who are blessed with a fair share of this world's wealth. The automatic meter has come like a good fairy to brighten the homes of our laboring classes—to cast into oblivion the miserable farthing dip, and to do away with the necessity of introducing into our domestic circle an explosive and dangerous oil, the accidents arising from the use of which are in number legion.

As a general rule, a new invention intended for the benefit of mankind has to undergo a long period of hostile criticism, during which it makes but little progress. The steam engine, electricity as a lighting medium and motive power, and even lucifers, although so striking an improvement on the old tinder box, with its flint and touchwood, have all had to survive a period of severe hostile criticism. But beyond the kindly humorous criticism by Jerome K. Jerome of the principle of automatic machines in general, we believe the invention of Messrs. J. Haynes, T. Thorpe, and T. Gardner Marsh has been the exception which proves the rule. The meters have come into popular favor with almost phenomenal speed, and no wonder; for it is not exaggeration to state that they have solved the problem of making gas available for all classes of the community in their homes, however humble—a fact which not alone benefits the masses enormously, but which is calculated to considerably enhance the profits of the various gas companies.

The whole credit of this new invention, or rather the credit of launching it into existence, is due to the Liverpool Gas Company, who started the ball, which has kept on rolling ever since, by placing some half hundred of the new meters experimentally in the artisans' dwelling in Cazneau street. In 1890 over 100 meters were at work in Liverpool, and from that time until now the difficulty has been to construct the machines quickly enough to supply the enormous demand which now exists. In 1891 the Company fixed 1,975 meters; in 1892 they fixed 4,038, and now, in Liverpool alone, there are between 8,000 and 9,000 automatic meters in the houses of those who hitherto have had to depend upon candles or oil for the illumination of their homes. Some idea of the popularity which these meters have attained may be gathered from the fact that the Liverpool Gas Company receive on an average over 100 applications per week for prepayment meters, from people who live in houses and cottages of small weekly rents.

Originally the automatic attachments were made at the works in Liverpool; but it quickly became obvious that if the venture was to succeed, adequate factories for turning out large numbers of meters were essential. A company was formed, known as the Automatic Gas Meter Company, Limited, and works are now in full swing both at Manchester and Leeds, where the cost of production is far less than it would be in this city. The fame of the new invention quickly spread to other large centers, and at the present time a rapidly-increasing demand for them has arisen in London, Leeds, Bristol, Manchester, Birmingham, Blackburn, Bolton and other towns. Indeed, all the large gas companies are seriously taking up the matter, and doubtless this prepayment system of supplying gas will enable them eventually to open up a field sufficient to amply compensate them for any deficiency which has arisen, and will arise in the future, owing to the spread of electricity for the lighting of large buildings and streets of towns and cities.

Like every other invention, the automatic gas meter has since its initiation been subjected to all kinds of improvements. In the original meters a certain amount of confidence had to be placed in the collectors, whose duty it is to unlock the drawer into which the pennies drop after being put into the slot by the householder, and see that the value of the total amount in the drawer corresponds with the quantity of gas registered as having passed through the meter. But experience has shown that some householders have endeavored, and succeeded, in playing tricks upon the unsuspecting automatic machines, and have questioned the veracity of the collector when he declared that too much gas had been used for the money remaining in the drawer. In such a case, the onus of proof would fall upon the gas company, and hence it might become a simple question of the reliability of the word of the collector or of the householder. And so the patentees knocked their heads together, and have now produced a meter which, as we have before said, even Jerome, in his most sensitive vein, could hardly find fault with. Both the collector and the householder may be dishonest; but, unlike the human heart, the metallic mechanism of those automata cannot be demoralized. In view of the householder are three dials, marked "£, s., and d.," and no sooner has a penny been dropped into the slot than the hand of the "D" dial records it. When twelve pennies have been dropped in, the "D" dial stands at "0," whilst the hand of the "S" dial records that one shilling's worth of pennies are in the drawer, and so on until twenty pounds' worth of gas is paid for. The hands can only move one way, so that by this invention the householder practically gets an indisputable receipt for the pennies he puts into the slot and the total amount he has paid for his gas. Another point in the latest meter is an indicator which shows how many feet of gas are in the meter "paid for but unconsumed." It is possible to pay for 300 feet in reserve, at which amount the mechanism will not allow any more pennies to be put in until some of the gas is used. When all the gas paid for has been used the flame does not at once go out; but under a new arrangement the meter automatically warns the householder that the supply is nearly exhausted by gradually lowering the flame at least one hour before turning the gas off.

In a previous notice we prophesied that there was not a shadow of doubt as to the rapid extension and development of the prepayment system of gas meters. In Liverpool the number of meters in use has been more than doubled, whilst their manifest advantages are becoming known all over the country. The advantage of gas over the proverbial farthing dip or the more dangerous oil lamp is too obvious to need comment. Householders need have no concern as to expense in fittings, as the gas company provides every new customer with a gas pendant for lighting purposes, and also with a boiling burner and a short length of india-rubber tubing. The great difficulty which the Liverpool Gas Company is anticipating is the enormous rush of applications for meters which invariably occurs at the approach of winter. A delay of some weeks may therefore occur before some of the desiring customers are supplied. And hence their importance of prompt application. As everything is fixed free, and as a householder need not use one pennyworth of gas unless he likes, it can make no difference whether he orders his meter in June or November, even if the short summer nights do away with the necessity of any illuminant being used.

In conclusion, we may add that whilst these meters so far have only been fixed in the small houses of 7s. 6d. per week and downward, there seems a probability that in the near future the advantage of a prepayment system will be extended to householders of greater means. We feel sure that to many such a system would be welcomed with open arms, and trust that before long that objectionable document—the quarterly gas bill—will have sunk into oblivion.

Concentric Wiring and Safety Wiring.

The *Electrical Review* says that in the very first systems of distribution of the electric light in multiple arc, which we believe was that proposed by De Khotinsky, it was suggested to use the earth as the return circuit, but when electric lighting became a commercial industry this was abandoned and all circuits were very carefully insulated from the earth. Gradually, however, it was found that certain indisputable advantages existed in grounding the neutral wire of a three-wire system;

and now the other extreme is reached by the advocates of what is called concentric wiring, who claim that great advantages, besides much greater safety, arise in grounding one wire of any system, be it three-wire or two-wire. Thus, after a complete cycle, we are led back to the very first method. This system, to which a reference will be found in our digest this week, consists essentially of two conductors, one outside of the other, enveloping it completely, the outer one being grounded as thoroughly as possible; all switches, cut-outs, etc., are made of metal instead of porcelain, and are grounded. The claims made for it are not unreasonable, and it seems to us that such a system is well worth more careful consideration, notwithstanding the prejudices against it. It should not be forgotten, however, that, unless a system is grounded thoroughly at both ends and at as many points as possible, leakage currents may arise due to a difference of potential of a few volts between different parts of the wire and the earth, such currents being sufficient to do considerable mischief in corroding the wires. In a system in which such earthed currents are used, as in lighting or railway work, if grounded at all, the wires should be very thoroughly grounded, not only at the two ends of that wire, but also at intermediate points; such grounds, furthermore, should be soldered contacts, as one should not trust to mere contact produced by pressure.

In connection with the system of concentric wiring, just referrred to, we may be pardoned if we call attention once more to a fact which is not understood and appreciated as much as it ought to be, especially by insurance companies, who are our dictators and rulers in regard to wiring. Some of their rules say that the two wires must be kept at a certain distance apart; as a matter of fact, however, it can readily be shown that the closer they are together the safer they are. This may readily be shown by nailing two bare wires on a board and moistening the wood between them; when they are two or three inches apart the leakage current will slowly set the wood on fire, and as this requires a very small current, the fire may be started without blowing the safety fuse. If, on the other hand, they are close together, separated only by a thin layer of insulating material capable of absorbing moisture, the current will become so great that the fuse will be blown immediately, before any charring or ignition can take place. The experiment is such a simple one that those who do not believe this statement can readily satisfy themselves by making an actual test. In making this test it is advisable to put some salt or soda into the water. Contrary to general belief, it therefore appears to be much safer to place the wires as close together as possible, provided proper precautions are taken to prevent the accompanying flash from igniting any very inflammable material.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

AT a meeting of the proprietors of the Honesdale (Pa.) Gas Company, held some days ago, it was resolved to reduce the selling rates by establishing the following net prices:

Monthly Consumption.	Net Rate per 1,000.
2,000 cubic feet	$2 15
3,000 "	2 00
5,000 "	1 75
Gas for fuel and power, any quantity	1 50

The schedule goes into effect on August 1st.

THE property and franchises of the St. Charles (Mo.) Gas Light and Coal Company, in conformity to the advertisement hitherto published in the JOURNAL, were disposed of at auction by Sheriff Steiner on July 12th. The bidding was spiritless, and the property was bought in, at the price of $5,000, by a syndicate of the former shareholders in the persons of Messrs. Theodore Bruere, Louis F. Martin and John A. Kellar. It is understood that all the old shareholders will participate in the reorganization, and that the plant will be enlarged and improved. The management will be entrusted to Mr. Kellar.

MR. JOHN E. GANNON, the Gas and Water Inspector for San Francisco, has filed his annual report with the Clerk of the Board of Supervisors. He states that the works of the San Francisco Gas Light Company have an estimated capacity of 6,700,000 cubic feet per 24 hours, and the capacity of the Pacific Gas Improvement Company is put at 2,500,000 cubic feet. The Inspector reports that his tests of the gas manufactured by both Companies failed to display any trace of sulphureted hydrogen. The average specific gravity of the gas made by the San Francisco Gas Light Company was .545, and that of the other Company is returned at .582. The average candle power of the gas furnished by the San Francisco Company was 18.64, and that of the Improvement Company was 18.27. The total amount paid by the city for gas during the year was $241,465.95, of which amount $206,933.34 was paid to the San Francisco Gas Light Company on account of gas consumed in street lamps. The amount paid for electric lights during the year was $74,598.19. The cost of water used for municipal purposes was $89,161.72. Of 88 water meters tested by the Inspector, 40 were found correct, 33 were slow, and 13 fast.

WE are indebted to Mr. B. F. Harding, Supt. and Treasurer of the Bridgeton (N. J.) Gas Light Company, who writes under date of July 15th, for the following: "At a meeting of the stockholders of the Bridgeton Gas Light Company, held at the office of the Company, on the 13th inst., the following Directors were elected: Daniel Elmer, Henry W. Elmer, M. D. Chester, J. Buck, William C. Mulford and Daniel Bacon. The Board organized by appointing the following officers: President, Daniel Elmer; Secretary and Auditor, Wm. C. Mulford; Superintendent and Treasurer, B. F. Harding. In giving you the above item, it just occurs to me that during the first 16 years of the Company's history there was no break in the Board of Directors, by death or otherwise; but during the last 16 there has been a complete change, and all by death. Since my connection with the Company, 20 years ago, there have been six deaths in the Directorate. However, the same harmony prevails that existed from the first. Our business is good, increasing year by year, notwithstanding the development of other modes of light."

THE Committee on Lamps, Wells and Pumps, of the Paterson (N. J.) Board of Aldermen, recently submitted a report recommending that the contract for lighting the public gas lamps be awarded to the United Gas Improvement Company, at its bid of $20 per lamp for one year, with the privilege of three years. Ald. Lang objected to a longer period than a year, as the courts had decided that a contract could not be awarded for a longer term, whereupon President Walls explained that it was the intention of the Committee to only award the contract for one year. The report of the Committee was accordingly adopted and the contract awarded.

THE Leominster (Mass.) Gas Company has declared a dividend of $2 per share.

"J. R.," under date of July 10th, writes about the Rockville (Conn.) Gas and Electric Light Company as follows: "In November, 1892, the Rockville Gas and Electric Company bought out the Rockville Gas Light Company. The new concern is composed of a syndicate of Connecticut capitalists, officered as follows: President, A. M. Young, of Waterbury; Treasurer, F. W. Marsh, of Bridgeport; Secretary, R. S. Hicks, of Stafford Springs. The local Manager is H. H. Walker, and the Superintendent of works is A. T. Dickinson. The Company has a fine plant for the manufacture of water gas, which is not only supplied to manufacturers, merchants and private families and public buildings, but also is converted into power by three of the largest gas engines built, by which the large dynamos are run which supply electricity for the city arc lights and for private arc and incandescent lighting as well. The further development of the electric plant is provided for by the addition of a steam engine of 300-horse power, which will be supplied with steam from two boilers, each of 150-horse power, and an alternating current dynamo of a capacity of 1,000 incandescent lights. A brick building will be erected to accommodate them. The gas plant is to be further added to by a gasholder of 100,000 cubic feet capacity, thus increasing the storage capacity to 200,000 cubic feet. This will, of course, enable the manufacture of gas to be conducted more economically and with better facility. When these extensive improvements are completed the Company will possess facilities which will insure a service entirely pleasing to its patrons, and which will be unexcelled. Every attention will be paid to the desires and needs of its patrons. A new feature is the introduction of gas as fuel for cooking and heating purposes. Many families are already enjoying this luxury, and the satisfaction and pleasure they express at the convenience and utility of the gas stove is rapidly causing their general introduction. Still another important branch of business is the electric wiring department, for electric bells, push-buttons and electric gas lighting."

MR. E. U. SLADE, Superintendent of the Hackensack (N. J.) Gas Light Company, writing under date of July 18th, says: "We are very much alive at the present time. We have just renewed one bench of 5's, and now are busy putting up two new benches of 5's, in place of 3's torn down. We have erected a brick building, 29 feet by 38 feet, with iron roof, to contain 9x12 feet purifying boxes, with 10-inch dry center seal, and shall put in condensers and scrubber and rotary ex-

hauster. These betterments, with the 12-inch main we laid through the principal street last year, and our new 60,000 feet holder, put us in good shape."

SOME days ago a slight explosion of gas occurred in the G and 26th street works of the Washington (D. C.) Gas Light Company, which resulted in painful but not serious injury to the Superintendent of the Company, Mr. John Leetch. For some days past workmen have been engaged in overhauling and repairing a duplicate plant for the manufacture of gas, and it was while engaged in inspecting a scrubber that the accident occurred. Mr. Leetch *ignited a match*, in order to make a close examination of the apparatus at one of the openings, when he was singed by a quick, sharp flame that struck him in the face and the hand in which he held the match. His face was badly burned and his whiskers were singed. He was fortunate in escaping with such slight injuries, which, however, were sufficient to keep him at home for some days. No damage was done to the machinery.

OFFICE OF P. H. & F. M. ROOTS CO., CONNERSVILLE, Ind., JULY 12, 1893.

To the Editor AMERICAN GAS LIGHT JOURNAL: We notice in your issue of the 3d inst. a full description of the new works of the San Francisco (Cal.) Gas Light Company. We would say that the machines for this Company were made by us, and consist of four No. 8 exhausters and engines combined on same bed-plate, each machine having a capacity of three millions cubic feet per day. Would also say that we will furnish the new 10-inch exhauster for the Canton (Ohio) Gas Light Company. This machine takes the place of one of our old 8-inch machines, and it will have a capacity of 900,000 feet per day. We are glad to say business still continues very good with us, in spite of the hard times. Yours, respectfully, D. T. ROOTS, President.

THE Berlin Iron Bridge Company, of East Berlin, Conn., is building the iron roof of the new purifier house for the Philadelphia City Gas Works, Philadelphia, Pa. The building will be 70 feet wide and 180 feet long, and the roof will be constructed entirely of iron, covered with slate. The new power house for the Worcester (Mass.) Traction Company will also be designed and built by Berlin folks.

WE understand that General Manager John W. Sanborn, of the Boston and Maine Railroad, has contracted with the New York Safety Car Heating and Lighting Company, of this city, for the erection of a Pintsch system gas plant, the Railroad people purposing to buy the plant outright and operate it. The generating house will probably be located near Austin street, in the Charlestown district of Boston, and will be capable of supplying all of the Boston and Maine cars. The Pullman cars on this road are now lighted with gas brought across the city in tanks from the southern stations, but as soon as the Pintsch plant is erected—work on it will be begun at once—all the Pullman cars coming to or going from Boston will obtain their gas supply from the Boston and Maine. It is the intention of Mr. Sanborn to begin equipping the coaches with gas appliances immediately, and to continue the work until all the cars are lighted by this means.

THE Cincinnati Gas Light and Coke Company has taken title to a piece of property having a frontage of 50 feet on the east side of Broadway, about 90 feet north of Court street. The consideration was about $15,000.

AT the annual meeting of the Milford (Mass.) Gas Company, the following officers were chosen: Directors, Chas. F. Claflin, B. E. Harris, E. L. Wires, N. B. Johnson, J. B. Bancroft, George A. Draper, F. J. Dutcher, J. E. Walker, I. N. Davis and L. H. Cook; Treasurer, B. E. Harris; Secretary, L. H. Harris; President, Chas. F. Claflin.

ONE result of the electric lighting squabble at Hillsdale was that the wires and so on of the system in use there, which is under the control of Mr. F. W. Stock, were inspected by the State Inspector, Mr. H. G. Fields and Electrician Rae, and pronounced dangerous and unsafe. On July 11th, an injunction was carried out of the Circuit Court at the suit of the City, enjoining Mr. Stock from operating the system until it was repaired and put in a safe condition. He was also ordered to remove all poles and wires from the streets and alleys in the city, except such as were used in the commercial circuit.

THE Directors of the Louisville (Ky.) Gas Company have re-elected the following officers: President, George W. Morris; Vice-President and Engineer, A. H. Barret; Treasurer, W. P. Lee; Secretary, E. S. Porter. Mr. J. B. Speed was appointed on the Executive Committee, replacing Mr. Attilla Cox, who personally requested that he be retired from the duties of the position. A dividend of 3½ per cent. was declared, and the discussion of the Company's affairs disclosed conditions and prospects satisfactory to the Directors. An official of the Company stated that the growth of the electric service was not curtailing the consumption of gas below the record of last year or former years. In fact, the gas service is being extended constantly, and shows an increase. This increase, of course, would be much larger were the electric light not in the field. Shareholders in the Louisville Gas Company are also shareholders in the electric department of the Company—more's the pity—the dividends declared resulting from the receipts of the two plants. The gas plant is the paying one, the electric not being able alone to afford a dividend. Nor will the electric plant ever earn a dividend until the city of Louisville agrees to pay something like a fair price for the arcs that light the city's streets. We have no hesitation in saying that Louisville is served with better arc lighting at cheaper rates than any other city in the world. No wonder Engineer Barret is getting bald and dreamy-eyed, considering the task that has been set for him in the Falls City.

THE St. Louis *Dispatch* recently said: "The citizens of Carondelet are much elated over the prospect of a war of extermination between the Carondelet Gas Light Company and the Carondelet Electric Light and Power Company. The Gas Company had a monopoly of furnishing light until the Electric Company came into the field, and then the business was divided. The advent of the Electric Light and Power Company gave the people a choice of lights at about the same cost, and subsequently the Gas Company increased the candle power of its product. The people have been paying $2.50 for 1,000 cubic feet of gas, with 20 per cent. off for prompt payment. The first of July, without any previous warning, the gas bills were made out at $1.25 per 1,000, with 5 per cent. off if paid before the 5th, which will be noted as a very marked reduction. It is said the Electric Light Company will meet it however, and go one better, by furnishing their patrons with electric fans at a nominal price. The Gas Company has been getting ready in a quiet way for its present onslaught on the Electric Company for some time. About a month ago, new and larger mains were put in, and it is now proposed to push the introduction of gaseous fuel. The Carondelet Gas Light Company's contract with the city does not expire for a number of years, and the Electric Company cannot get a contract for lighting the streets of Carondelet until it does expire.

THE Directors of the Oneida (N. Y.) Gas Light Company have declared a semi annual dividend of 3 per cent.

AT a special meeting of the Board of Public Works of Trenton, N. J., objection was made to the action of the Trenton Gas Light Company, which it was alleged had torn up several streets without permission from the Board. After some discussion, the following resolution, presented by Mr. Hanson, was adopted:

"*Resolved*, That the Street Commission be hereby instructed to confer with the Trenton Gas Light Company, and inform them that it is necessary that they hereafter procure a permit before making excavations in streets for laying mains, and also to advise them that the work now in process in West State street must be done under his supervision pending the preparation of an ordinance."

EARLY this month Judge Olmstead rendered a decision in the stubbornly contested case of the Warren (Pa.) Gas Light Company against the Pennsylvania Gas Company. The action was a bill in equity seeking to restrain the Pennsylvania Company from furnishing, and their patrons from using, gas for lighting purposes, the artificial Gas Company claiming that it had the exclusive right to furnish gas for illuminating in Warren. Judge Olmstead refuses to grant the injunction prayed for, thus establishing the right of the Pennsylvania Company to use its product for any purpose desired.

THE floating indebtedness of the Elmira (N. Y.) Gas and Illuminating Company, the appointment of a receiver for which was reported in our issue for last week, amounts to about $500,000.

AT the annual meeting of the Peoples Gas Company, of Rutland, Vt., much interest was shown by the shareholders, who were present in goodly numbers. The annual reports disclosed a most satisfactory condition of the corporation's affairs, and a semi annual dividend of 3 per cent. was declared. Further, a neat sum was carried to the surplus fund account. The following Directors were chosen: J. W. Cramton, E. D. Keyes, W. B. Mussey, G. R. Bottum, J. N. Baxter, S. M. Wilson and J. A. Sheldon.

In the public arc lighting specifications for Toledo, Ohio, which city will, on August 7th, open bids for the public lighting by means of electric and gas lights, it is set forth that "the arc lights are to be of nominal 2,000 candle power, the electrical energy consumed in the lamp, expressed in watt power, to be the basis of determining the light intensity, the equivalent of 450 watts to be expended in the arc. Each conductor or lamp circuit to maintain a current strength of not less than 9 5 amperes, and each arc to indicate an average of not less than 45 volts difference of potential as applied to continuous current systems, relative standards and equivalent to alternating current systems."

At a special meeting of the City Council of Brazil, Ind., the main business transacted was the granting of a franchise to Messrs. John D. Sourwine and Scott W. Carpenter to use the streets and alleys of the city for the purpose of placing gas mains thereunder. Councilman Moore opposed the granting of the franchise, on the ground that the city could profit by inviting others to compete therefor. He also thought the parties, if granted the franchise, could afford to furnish the city building and the water works with light and fuel in exchange for free water and taxes remitted. Sourwine, on behalf of the Company, said that this was asking too much. They would agree to light and heat the city building, but could not furnish fuel for the water works, in return for free water and exemption from taxes. Councilman Holiday said no exclusive franchise could be granted to any Company, and he believed no exchanges should be made between city and corporation, the better plan being for each to pay for what it received. Councilmen Scofield and Cook agreed with Councilman Holiday, and the ordinance passed, Councilman Moore voting No. The ordinance grants the right of way over and along and under the streets, avenues, alleys and public grounds of the city; provides that a bond of $10,000 shall be executed to hold the city harmless from injury to any person or property which may result from negligence; that not more than 300 feet of any street shall be obstructed at any one time during the laying of pipes; that streets must be restored to as good condition after laying the pipes as before the work was begun; subjects the Company to sanitary and police regulations under the control of Council; limits charges for service to 50 cents per 1,000 cubic feet for fuel gas, and $1 per 1,000 for illuminating gas; the quality of the gas shall not be less than 16-candle power; and the charter is to be in force for 40 years.

The Edison Electric Illuminating Company, of Boston, Mass., has applied to the Board of Gas and Electric Light Commissioners for permission to increase its capital stock in the sum of $500,000.

The Committee of the Whole, of the City Council of Santa Barbara, Cal., has resolved to discontinue the lighting of the streets by means of arc lamps, save those on State street and one lamp at the railroad depot on Chapala street. The service was too expensive.

Maj. Byrne, of New York, Treasurer of the Detroit Gas Company, was in Detroit some days ago. In conversation with a representative of the *Free Press*, he was asked what the Gas Company was going to do about accepting a new franchise from the city. He declared that nothing would be done, as it was thought the city was not recognizing the obligations of existing contracts. He was asked if it would not settle the gas war. "I think not," was the reply. "If the franchise of the Michigan Gas Company is not good after the expenditure of a large amount of money in good faith under it, of what value would a new franchise be?" "What is the Gas Company going to do?" "It will continue to do business and keep faith with the city and the people, and defend its rights at all hazards. It is a citizen in good standing, pays taxes, obeys the law and does not infringe the rights of anyone. It is entitled to protection from the city authorities, which, if denied, will compel it to rely upon a higher law. The personal ambition of the Mayor is fortunately not the law of the land." "You are not willing, then, to treat with the city?" "Oh, yes; we are willing to treat with the city," said Mr. Byrne; "but we are unwilling to be coerced. Our position here, we think, entitles us to very different treatment. We came to Detroit in 1889, invited by an apparently fair public sentiment, which promised protection and encouragement to outside capital, and under your laws we invested nearly 2,000,000 of money in the Michigan Gas Company. In doing this we gave to Detroit a character for enterprise which we think did her no harm. The time came when protection to our patrons prompted us to provide for a supply of artificial gas against any possible shortage of natural gas through accident or otherwise. Investigation convinced us that this could be accomplished by building fuel gas works sufficiently extensive to enable us to supply the manufacturers of Detroit with fuel, providing at the same time at comparatively small additional cost for our domestic patrons. This contemplated a very large outlay of money, but the outlook was so promising—aided and encouraged by some of the largest manufacturers of Detroit—that we felt it would be wise to make it, not only as security to our patrons, but to our already large interests here. After investigation by expert engineers options were secured on sites for works, the plan being to erect two mammoth plants. We went so far as to complete plans and estimates, and negotiate for transplanting to Detroit certain large manufacturing industries in which we were interested, so as to increase the consumption of our gas. It was suggested about this time that we purchase existing gas plants and build on them. Believing that no good could come to us by injuring existing vested interests, or people who were identified with the prosperity and development of the city, we determined to alter our plans and acquire these properties. This purchase would enable us to utilize one of the old plants for fuel purposes and necessitate the building of but one new one, besides enabling us to put our plans into execution this year, instead of next. Time with us is money. We felt that our enterprise would be appreciated and our capital welcomed. If you have kept pace with the controversy, you know how near we have been able to realize our plans. On every hand we have met hostility and abuse, and in this position we still find ourselves. We signalized our entry into the illuminating gas field by reducing the price from $1.50 to $1.25, and we improved the quality of the gas so that now one burner gives better service than two did before; by this we hoped to stimulate consumption to a point which would enable us to reduce the price still further—simply pursuing a policy we have successfully followed in other cities to the advantage of the Company and the satisfaction of its patrons. From the moment we embarked in these later enterprises," Major Byrne continued, "we became the object of abuse and false accusation, and victims of bad faith in the so called revocation of the gas franchises."

Velocity of the Transmission of the Flame of Firedamp.

The burning produced at one point of a gaseous combustible mixture is transmitted with a velocity depending upon a great many different conditions, *i. e.*, proportions of the gases mixed, the rest or motion of the gaseous mixture, and nearness to solid cold bodies. The French fire damp commission, by a number of experiments, tried to determine the influence of these several circumstances, which are intimately connected with the degree of security obtained by lamps.

The velocity of propagation varies, firstly, with the proportion of firedamp contained in the mixture, and it evidently neither reaches a maximum at either of the two extreme limits of combustibility, nor does it correspond, as one might be led to think, to the mixture for complete combustion, but rather to a mixture containing a certain excess of combustible gas. The highest velocity observed has been 1.97 feet per second.

Proportion of $C_2 H_4$ in 100 Vols. of the Mixture.....	6	8	10	12	14	16
Velocity in Feet	0.13	0.72	1.38	1.97	1.21	0.24

In a mixture containing an excess of oxygen, the substitution of nitrogen for the oxygen which is in excess of that necessary for combustion does not effect the velocity of propagation. Carbonic acid, on the other hand, perceptibly lowers this velocity. The preceding results apply to mixtures at rest, while the velocities are changed entirely when the gaseous masses are in motion during combustion.

Mixtures which at rest give the slowest propagations may become instantaneous, that is to say, truly explosive when they are stirred up at the moment of combustion by a very energetic movement, such as would be produced by a jet of gas escaping at a high velocity into a mass of gas at rest. This is the explanation of explosions of firedamp in mines. If the velocity of propagation never exceeded 1.97 foot per second the mechanical effects would always be nothing and the workmen could escape from the flame.

Precise experiments have never been made upon the velocities thus developed. It is only known that in the laboratory in small tubes 1.18 inches in diameter and 6.56 feet long we can obtain velocities greater than 65.6 feet per second, and it is perhaps by hundreds of feet that the extreme velocity obtained in the explosions of firedamp should be calculated.

The spontaneous movement of gaseous masses during combustion is not an exceptional phenomenon; it is, on the contrary, the rule, and in order to avoid it only partially in laboratory experiments, it is necessary to take very special precautions.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,

PROPRIETORS.

MONDAY, JULY 24, 1893.

The Market for Gas Securities.

The general share market still remains in a most depressed and unsettled condition, and values are at sixes and sevens. Consolidated is reported at opening to-day (Friday) at 119 to 120½. Yesterday 200 shares were sold on the Exchange, at 120. An order for 500 shares would likely send the quotations up to 125. The stock is cheap; very cheap. Other city shares are dull and quiet.

In Brooklyn the situation is as complicated as ever, and the *Eagle* has it that quite a change has been made in the *personnel* of the Directorate of the Williamsburgh Gas Light Company, the story going that Messrs. Wm. Rockafellar, H. H. Rogers, Benjamin Brewster and John T. Willets (these representing the Standard Oil Company interest in the Gas Company) were dropped at the annual election. It is also said they were replaced by persons in the interest of Mr. Addicks. It is also said that the deposed quartette have a positive interest in the welfare of the Equity Gas Light Company; but there are mere rumors, and are only given as such. Brooklyn shares meanwhile show no change of moment. In outside shares the feature was the break in Chicago gas, which sold down to 51, subsequently recovering to 54¼, the opening bid price to day. This stock intrinsically is worth par. Bay State is at 11¾ to 12, and Baltimore Consolidated is reported at 53¾ to 54¼.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks,

16 Wall St., New York City.

July 24.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share. ☜

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	119	120½
Central	500,000	50	90	95
" Scrip	220,000	—	—	100
Equitable	4,000,000	100	170	175
" Bonds	1,000,000	—	106	108
Harlem, Bonds	170,000	—	—	—
Metropolitan, Bonds	658,000	—	110	115
Mutual	3,500,000	100	139	142
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	—	—
" Bonds	150,000	—	—	100
Richmond Co., S. I.	346,000	50	—	—
" Bonds	20,000	—	—	—
Standard Gas Co—				
Common Stock	5,000,000	100	35	40
Preferred	5,000,000	100	80	85
Yonkers		50	112	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	—	113
Citizens	1,200,000	20	99¾	100
" S. F. Bonds	320,000	1000	—	103
Equity Gas Light Co	2,000,000	100	—	—
Bonds	1,000,000	—	—	60
Fulton Municipal	3,000,000	100	125	—
" Bonds	300,000		102	—
Peoples	1,000,000	10	—	92
" Bonds (7's)	368,000	—	100	—
" " (6's)	94,000	—	100	—
Metropolitan	870,000	100	—	123
" Bonds (5's)	70,000	—	100	—
Nassau	1,000,000	25	150	—
" Ctfs	700,000	1000	99	100
Williamsburgh	1,000,000	50	130	—
" Bonds	1,000,000	—	107	110
Out of Town Gas Companies.				
Boston United Gas Co.—				
1s Series S.F. Trust	7,000,000	1000	67	70
2d " " "	3,000,000	1000	45	50
Bay State Gas Co.—				
Stock	5,000,000	50	11¾	12
Income Bonds	2,000,000	1000	40	—
Buffalo Mutual, N. Y.	750,000	100	110	—
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	155	160
Chicago Gas Company.	25,000,000	100	54¾	55
Chicago Gas Light. & Coke Co.—				
G't'd Gold Bonds	7,650,000	1000	85	90½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1000	—	101
People's Gas and Coke Co., Chicago—				
1st Mortgage	2,100,000	1000	—	108
2d "	2,500,000	1000	104	105
Consumers Gas Light Co., Jersey City	2,000,000	100	25	—
Bonds	600,000	1000	85	90
Cincinnati G. & C. Co.	7,000,000	100	192	—
Consumers Toronto	1,600,000	50	190	191
Central, S. F., Cal.			—	100
Capital, Sacramento, Cal			—	55

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Ironwork Complete for Two Benches of 3's.

Four Purifiers, 4 feet diameter, dry center seal.

One Connelly Steam Jet Exhauster, with all the 6-inch connections.

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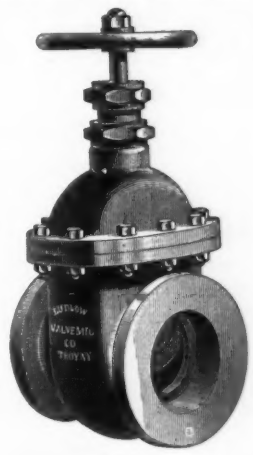

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The "Little Giant" Water Gas Generator.

In order to correct some of the drawbacks in existing apparatus, and to bring Water Gas Generators within the reach of all Gas Companies, I have completed a Gas Generator (which can be seen in daily operation) having many advantages over all others.

This Generator takes but little room. It requires no change to be made in the height or depth of gas houses. It is more easily repaired when necessary. It is simpler and easier operated. It makes *more good gas from a given quantity of stock.* It makes good gas from *cheaper stock.* It makes gas of *any desired candle power* up to thirty without smoke. It makes a faultless gas from whatever gas producing materials are cheapest in the locality where required, using hard coal or coke in connection with Lima crude or any other crude petroleum or its distillates, including *Naphtha of any specific gravity.* I build these Generators with any required capacity from 3,000 cubic feet per hour upward.

In more than one half the gas works in the country the "Little Giant" will enable *one man* to easily make, in *five hours,* all the gas needed for the *twenty-four hours.*

Everything is guaranteed, including durability and capacity of the Generator, the quality of the gas, and its cost.

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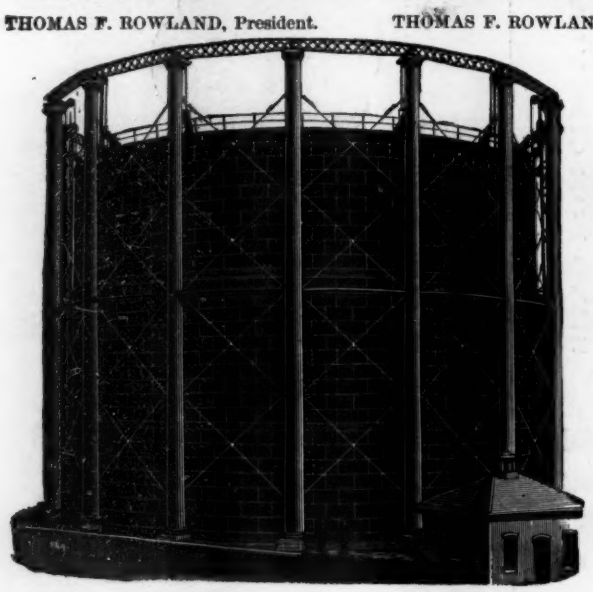

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RANGING IN PRICE FROM $3.00 to $63.00.

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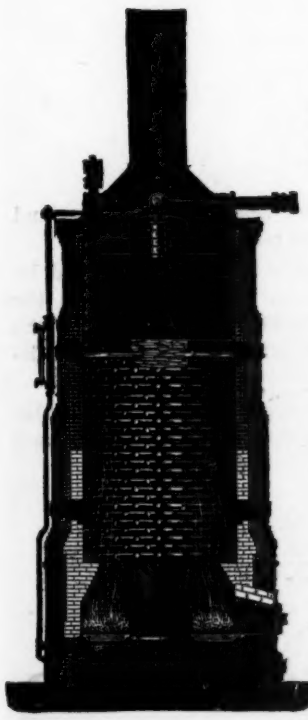
The HAZELTON BOILER Frequently Called The PORCUPINE BOILER

Patented in America and Abroad.



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A Common-Sense High-Pressure Boiler made in a Superior Manner.
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Standard Sizes, 50 H.P. to 500 H.P.

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Cable Address, "PAILA," NEW YORK.
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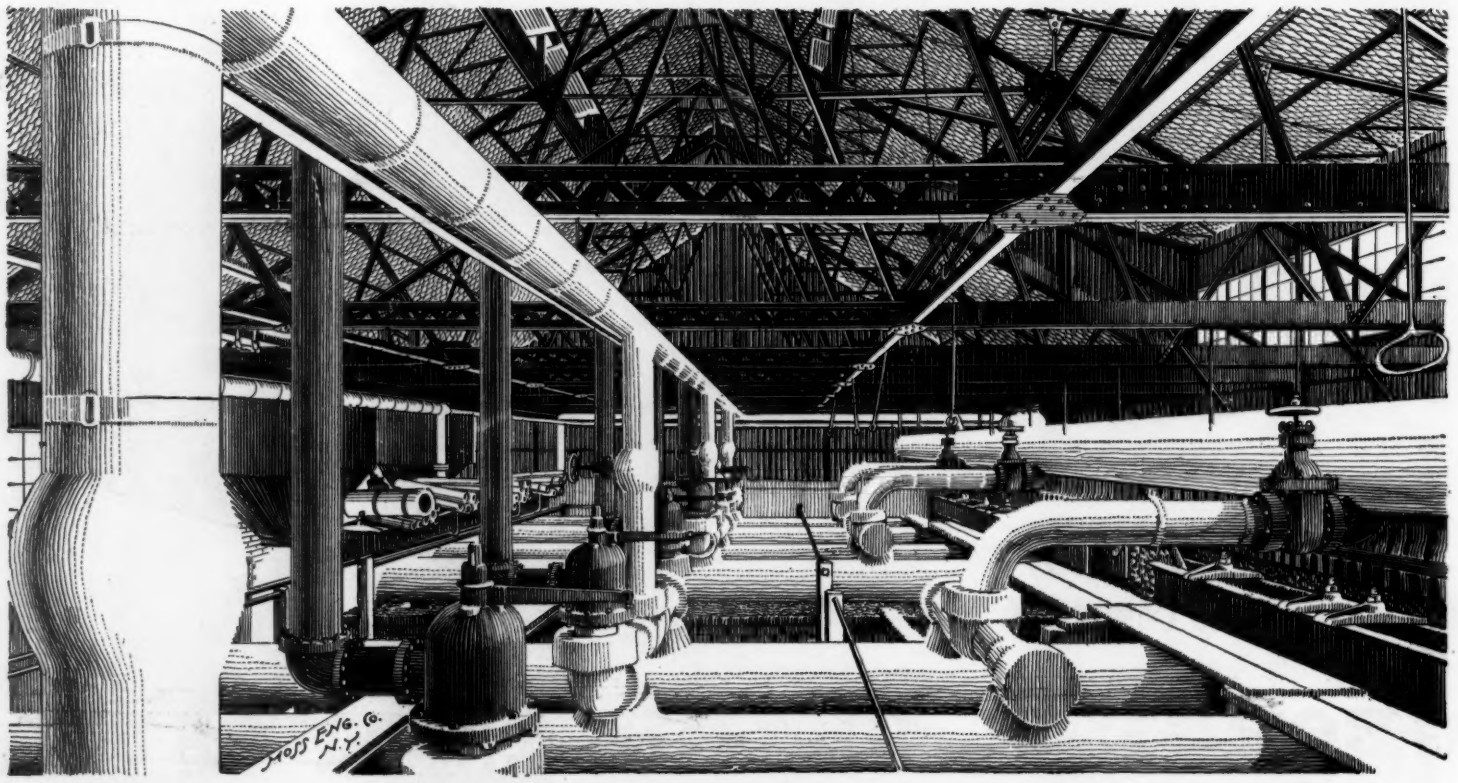

The above illustration is taken direct from a photograph, and shows the construction of a Boiler House designed and built by us for the well known Silk Manufacturing Company, Cheney Brothers, at South Manchester, Conn. The building 48 ft. in width and 74 ft. in length, with brick walls to the height of the top of the boilers; above that the construction is entirely of iron, the Roof being covered with our Patent Anti-Condensation Corrugated Iron Covering, which we guarantee not to drip in the coldest weather. The construction is absolutely fireproof.

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GAS.

MR. WALTON CLARK, Assistant General Superintendent, United Gas Improvement Co.:

Dear Sir—In accordance with your request, I have made several tests of the new Welsbach mantel (called No. 169) for candle power and efficiency, and I herewith submit the following results:

	Candle Power.	Pressure.	Gas Consumed.	C.P. per Cu. Ft.
Average of Test No. 1,	67.05	.95 in.	2.6	25.70
" " No. 2,	63.86	1.00 in.	2.86	22.30
" " No. 3,	72.50	2.1 in.	2.87	25.26

The above averages are the results of trials on three different occasions, and in each case the mantles tested were made from a different lot of fluid.

The mantles used in the above tests were selected at random, and all had been dipped in kristaline and dried ready for shipment.

It is quite possible that better results could have been obtained by manipulating and readjusting the position of the mantles on the galleries, and also by waiting a longer period after burning off the kristaline; but I considered such fine adjustment undesirable in determining the commercial candle power.

These tests were made on a bar photometer against a regular Edgerton standard slit. The candle power of the slit was 6.18, and the gas used was Gloucester City water gas, 26 candle power.

Very truly yours,

(Signed) C. H. PAGE, JR., M.E.

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Newbigging's Handbook for Gas Engineers and Managers.

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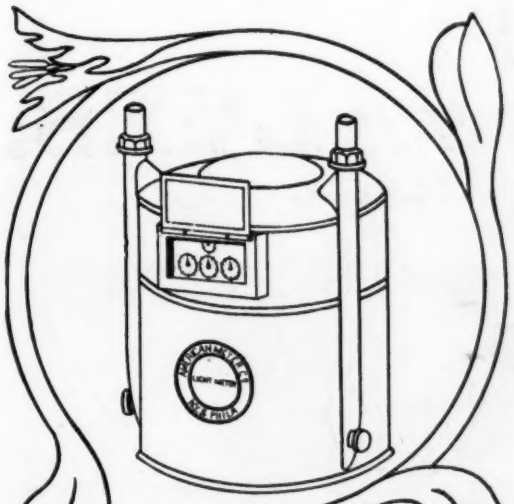

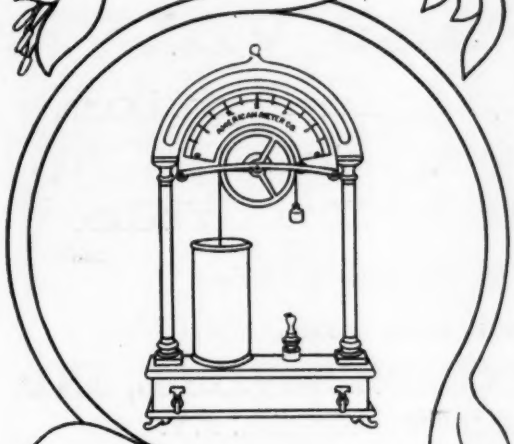

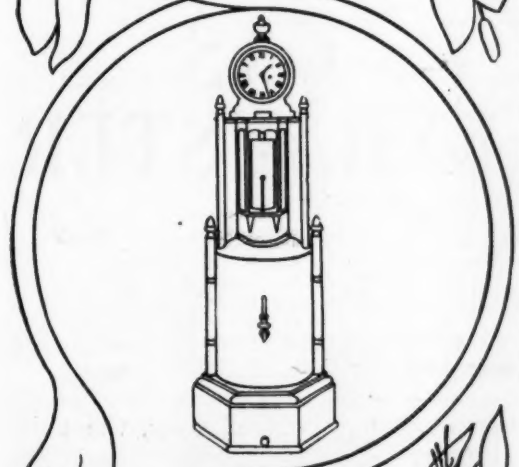

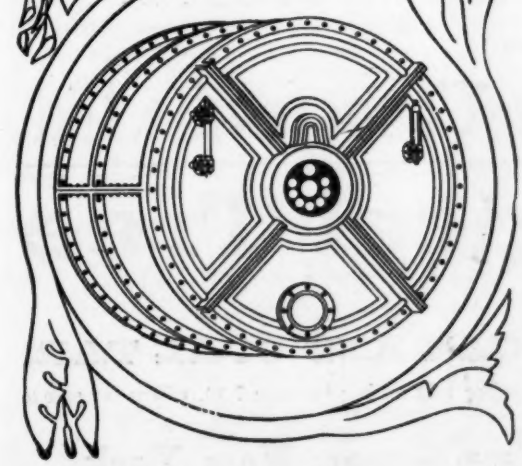

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NEW YORK and PHILADELPHIA.

CHICAGO, CINCINNATI,

ST. LOUIS, SAN FRANCISCO.

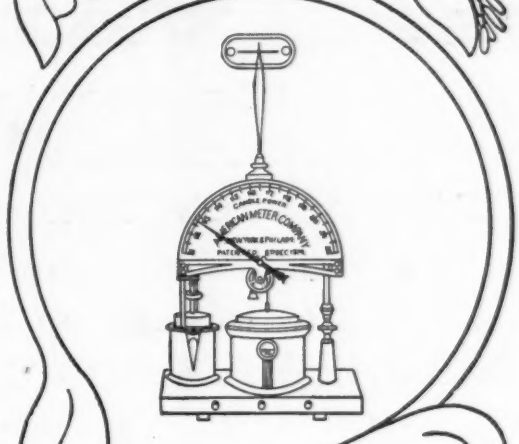
PUBLIC LIGHTING TABLE.

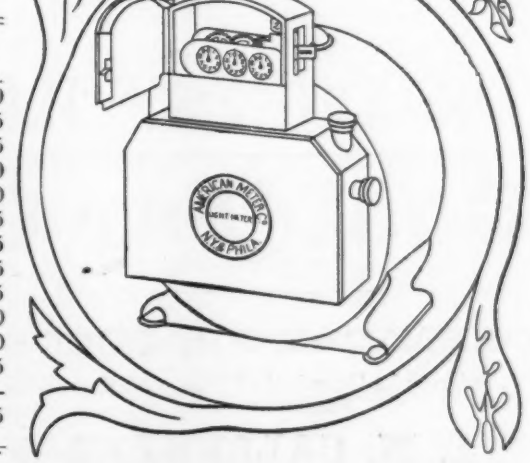
AUGUST, 1893.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Tue.	1	7.40 PM	10.30 PM	7.10	3.30
Wed.	2	7.40	10.50	7.10	3.30
Thu.	3	7.40	11.10	7.10	3.30
Fri.	4	7.40 LQ	11.40	7.10	3.30
Sat.	5	7.40	12.10 AM	7.10	3.30
Sun.	6	7.40	1.00	7.10	3.45
Mon.	7	7.40	1.50	7.10	3.45
Tue.	8	7.40	4.10	7.10	3.45
Wed.	9	7.40	4.10	7.10	3.45
Thu.	10	7.40	4.10	7.10	3.45
Fri.	11	7.30 NM	4.10	7.10	3.45
Sat.	12	7.30	4.10	7.10	3.45
Sun.	13	7.30	4.10	6.55	4.00
Mon.	14	7.30	4.10	6.55	4.00
Tue.	15	7.30	4.10	6.55	4.00
Wed.	16	8.30	4.10	6.55	4.00
Thu.	17	8.50	4.10	6.55	4.00
Fri.	18	9.20	4.10	6.55	4.00
Sat.	19	9.50 FQ	4.20	6.55	4.00
Sun.	20	10.30	4.20	6.45	4.10
Mon.	21	11.10	4.20	6.45	4.10
Tue.	22	12.10 AM	4.20	6.45	4.10
Wed.	23	1.10	4.20	6.45	4.10
Thu.	24	2.10	4.20	6.45	4.10
Fri.	25	No L.	No L.	6.45	4.10
Sat.	26	No L.	No L.	6.45	4.10
Sun.	27	No L. FM	No L.	6.30	4.20
Mon.	28	7.10 PM	8.30 PM	6.30	4.20
Tue.	29	7.10	8.50	6.30	4.20
Wed.	30	7.10	9.20	6.30	4.20
Thu.	31	7.10	9.40	6.30	4.20

TOTAL HOURS LIGHTING DURING 1893.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January...	217.30	January...	423.20
February..	200.30	February..	355.25
March	177.50	March	355.35
April.....	160.30	April.....	298.50
May.....	149.00	May.....	264.50
June.....	140.30	June.....	234.25
July.....	143.40	July.....	243.45
August....	154.50	August....	280.25
September.	171.50	September.	321.15
October....	202.20	October....	374.30
November.	221.30	November.	401.40
December.	248.50	December.	433.45
Total..	2188.50	Total..	3987.45





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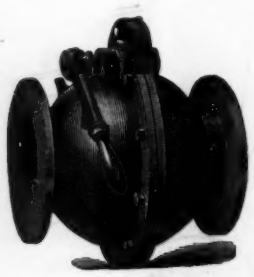
GAS AND BYE-PASS VALVES.



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Reliable
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The attention of Gas Engineers and Manufacturers is respectfully invited to our new

CYCLOIDAL EXHAUSTER,

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SIMPLICITY * EFFICIENCY * DURABILITY.

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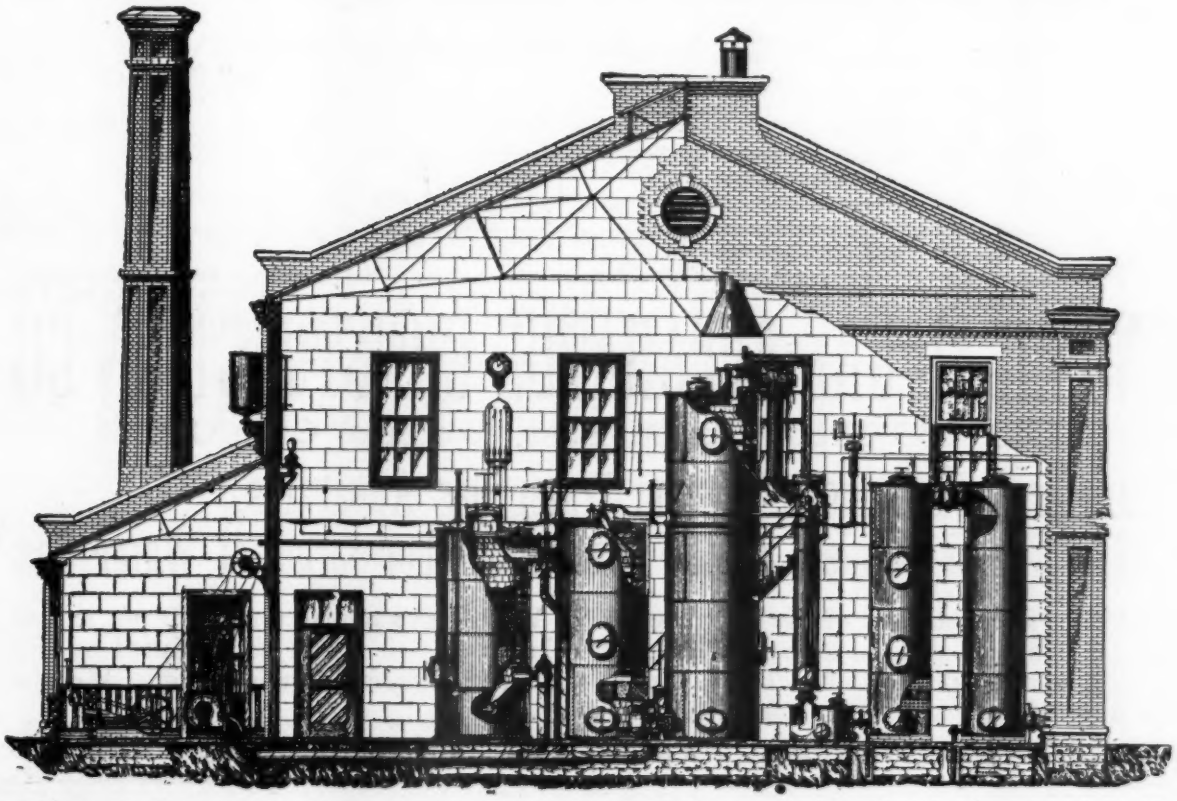

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Gentlemen—We are in receipt of your favor of the 16th, advising us the National Gas Light and Fuel Company, of Chicago, will discontinue their advertisement from July 1st, and offering us the space occupied by them since 1885.

In thanking you for remembering us and for your kind expressions, it affords us great pleasure to advise you that we have decided to accept your proposition, as we fully realize the excellent advertising facilities afforded through the GAS LIGHT JOURNAL. In doing so we are also complying with repeated suggestions from the many friends we have gained in the fraternity, who have tried us with their orders. Our previous hesitancy in extending our advertising was due to the fact that, with our best efforts, we were unable to increase our facilities to meet the growing requirements; but with our new shop, to be completed this month, and which is being fitted up with special tools designed for the finishing of Gas Apparatus, we feel confident of being able to turn out all work intrusted to us promptly and in a first-class manner. We have taken the precaution to provide for any future extensions which may prove necessary. We now hope to extend our business relations with the fraternity, and will do our best to deserve it by prompt and first-class work and reasonable prices.

Yours very truly,
THE WESTERN GAS CONSTRUCTION CO.
By O. N. GULDLIN, Prest.

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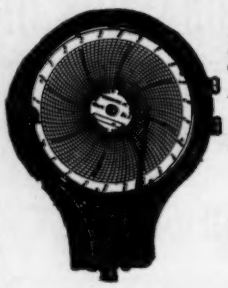

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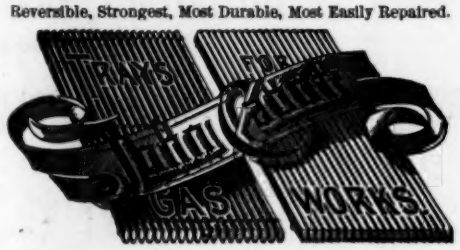

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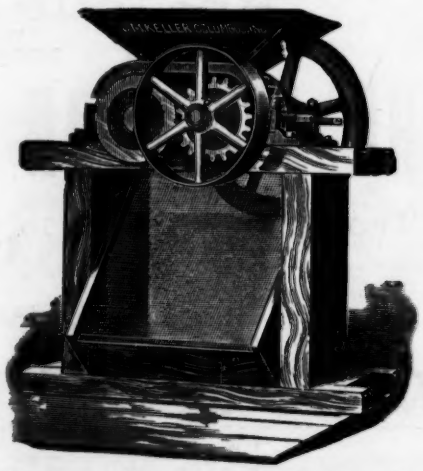

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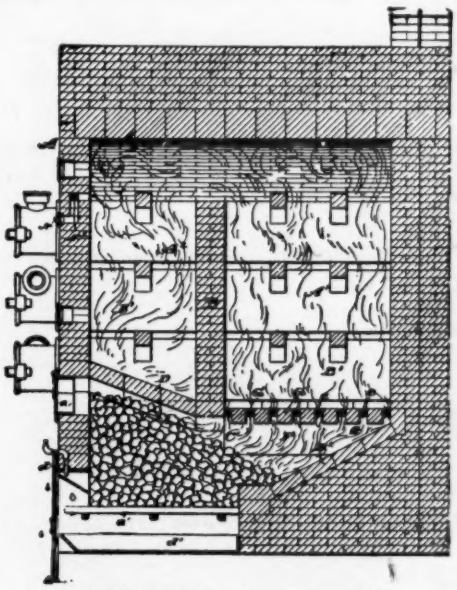

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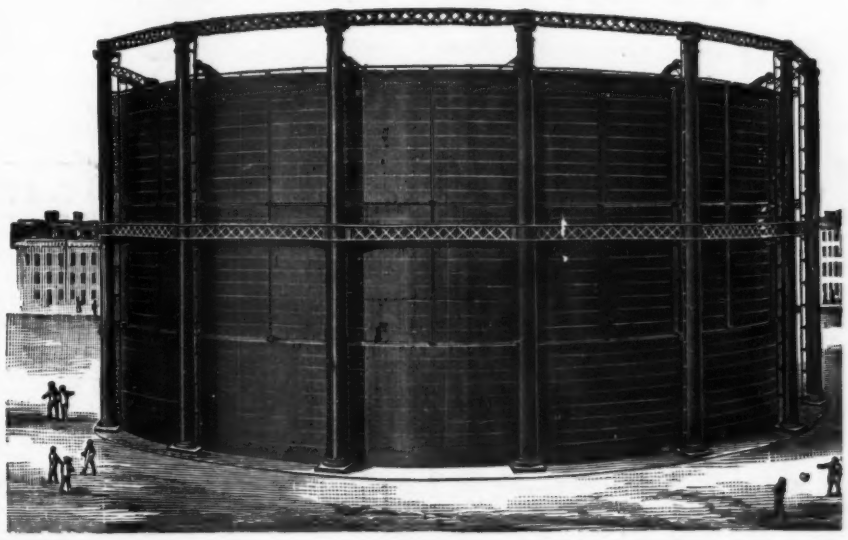

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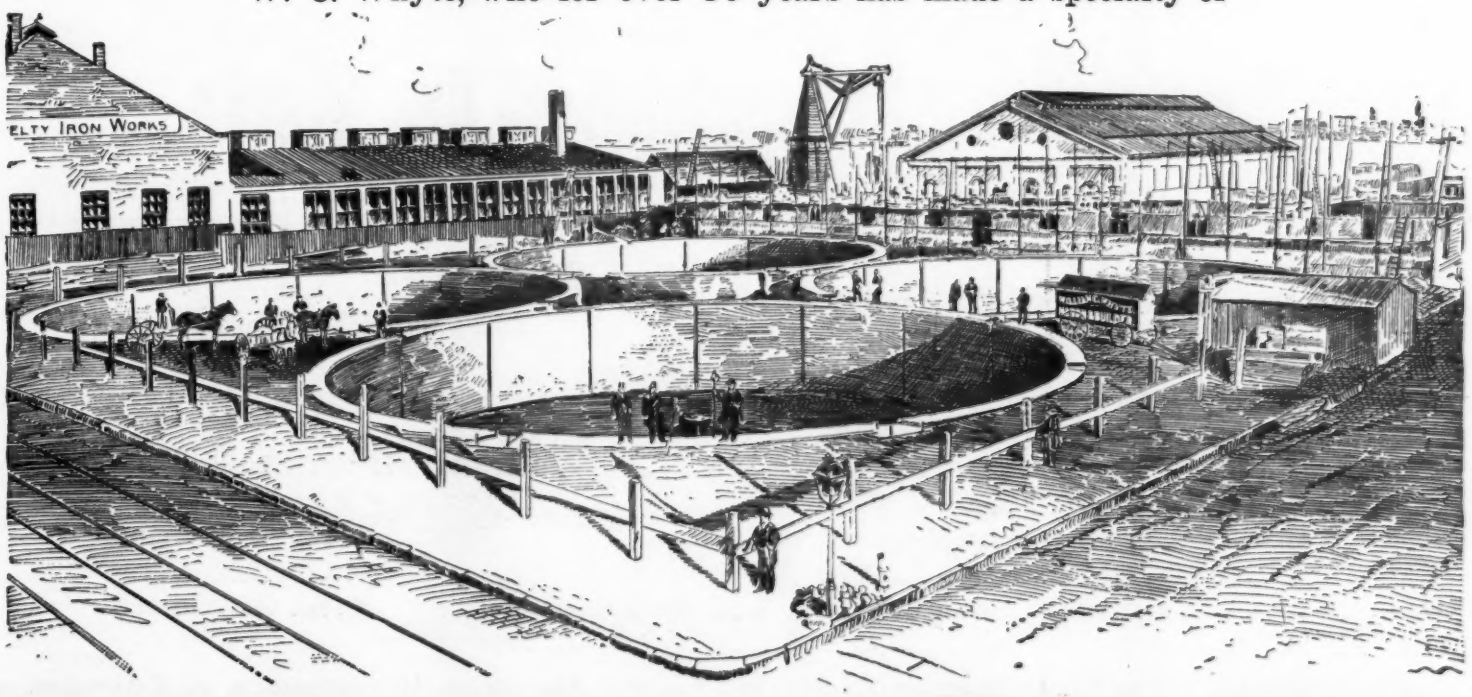

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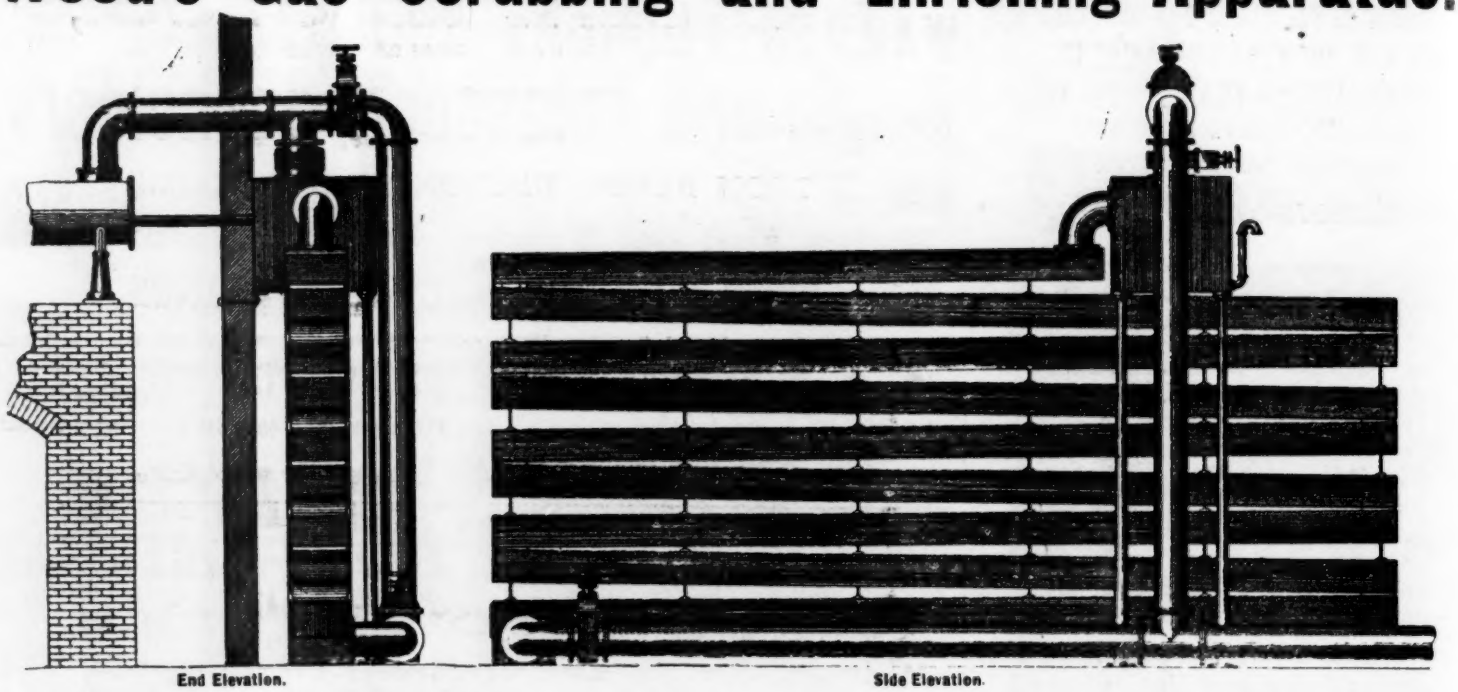

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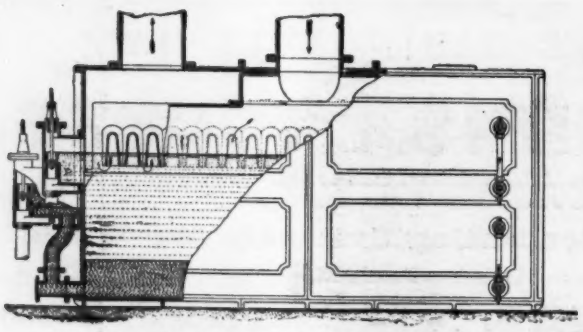

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For the Year 1892.

An Analysis of the Accounts of the Principal Gas Undertakings in England, Scotland, and Ireland. Being the Twenty-third Year of Publication. Compiled and Arranged by

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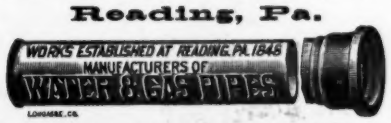

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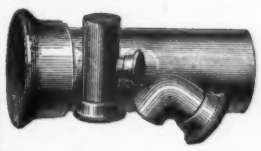

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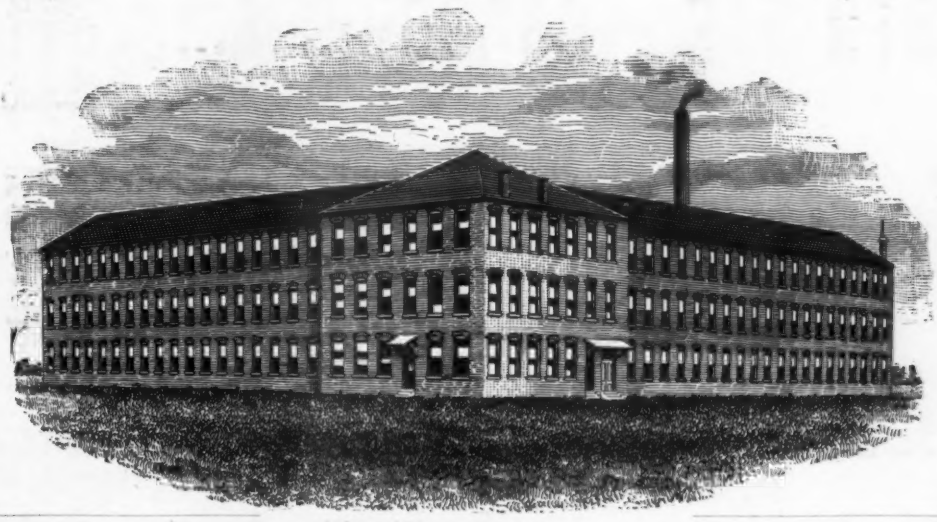

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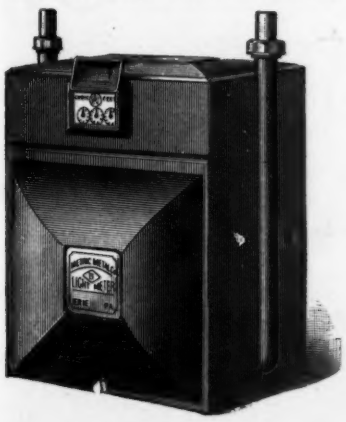

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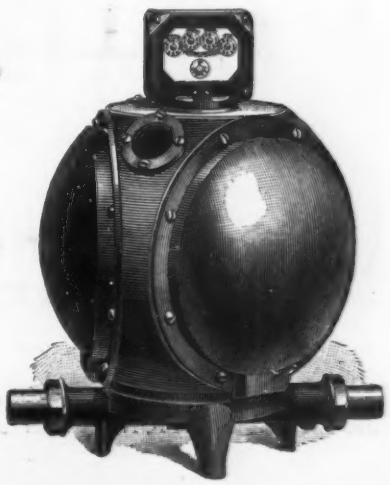

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The superior feature of this meter is that it avoids the danger of displacement of the valves, and consequent loss of gas, either in shipping, handling, or by dishonest consumers.

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Full descriptive circular sent on application

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NOW in use . . . . . .

To what extent does **Your Company** participate in this amount?

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1st. Because rates on Electric current are on the increase.

2d. Because improvements in our "Otto" Gas Engines have been wonderful and numerous, and have cheapened their cost.

3d. Because prices for Gas are lower than ever before.

4th. Because you can therefore make a price for Fuel Gas sufficiently low to leave you master of the situation as regards competing systems of power—steam or electricity.

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Mr. Thomas Fletcher, well known in the Gas Industry, gives his opinion on this question as follows

"It is essential for economical working, and consequent low prices, that the plant as a whole shall be utilized as far as possible for the whole 24 hours every day, summer and winter alike. If this ideal state of things could be attained, about three or four times the output could be sold with practically no addition to the capital expenditure, *and consequently the profits would be increased to four or five times the present amount*, or even more, as the staff expenses would not rise in proportion, an account of £25 being quite as easy to deal with as one of £5, and requiring no additional office work. Instead of being the best customers, *shopkeepers* and *owners of large works* are really *the worst* the gas industry has to deal with, spite of the large total amount, and the reason is simple. The consumption is enormous during two or three hours in winter, entailing the necessity of enormous holders and very large distributing plant, all of which is absolutely idle during the summer. THE BEST OF ALL CUSTOMERS ARE THOSE WHO USE GAS FOR ENGINES, workshop and industrial purposes, as these will use a steady supply for about ten hours daily, winter and summer alike, and *these are the users worthy of the greatest consideration.* Next to these come the users of gas cooking appliances and gas fires, they also being practically steady users for long hours both in the winter and summer. Domestic lighting does not come out anything so favorably, as the consumption in the winter averages over double that in the summer, entailing the loss on idle plant during a large portion of the year. The dream of the gas engineer is a large summer and 'day gas' consumption, and on *these depend large profits and economical working.*"

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